file no: 2792 PIBS

ONTARIO TYPICAL RANGE OF CHEMICAL PARAMETERS IN SOIL, VEGETATION, MOSS BAGS AND SNOW

DECEMBER 1993

Ontario

Ministry of
Environment
and Energy

ISBN 0-7778-1979-1

ONTARIO TYPICAL RANGE OF CHEMICAL PARAMETERS IN SOIL, VEGETATION, MOSS BAGS AND SNOW

DECEMBER 1993

Cette publication technique
n'est disponible qu'en anglais.

Copyright: Queen's Printer for Ontario, 1993
This publication may be reproduced for non-commercial purposes
with appropriate attribution.

PIBS 2792

Ontario Ministry of Environment and Energy

"Ontario Typical Range" of Chemical Parameters in Soil, Vegetation, Moss Bags and Snow

Phytotoxicology Section
Standards Development Branch

Version 1.0a

April, 1994

Table of Contents

Section 1 Background 1

Section 2 Ontario Typical Range Model 2

Section 3 Use Categories/Receptors/Parameters 4
  3.1 Land Use Categories 4
  3.2 Receptor Types 6
    3.2.1 Vegetation 6
    3.2.2 Soil 7
    3.2.3 Snow 8
    3.2.4 Moss Bags 8
  3.3 Analytical Parameters 8

Section 4 Review and Maintenance Process 14

Section 5 Interpretation and Application of the Typical Ontario Range 14

Section 6 Ontario Typical Range Distributions 15
  6.1 OTR's for Soil 16
  6.2 OTR's for Vegetation 192
  6.3 OTR's for Mossbags 192
  6.4 OTR's for Snow 192

Section 7 Summary of OTR_{98}s 192

Appendix A: OTR Model Statistics and Graphics A1
  Appendix A1: Distribution-Free Confidence Intervals for Quantiles A1
  Appendix A2: Kolmogorov-Smirnov Two Sample Test A5
  Appendix A3: Method for Determining OTR_{98} and Related Values A6
  Appendix A4: Details of Graphical Representation of OTR Distributions A6

Appendix B: Test Parameter Information B1

Appendix C: Derivation of 2,3,7,8-TCDD Toxic Equivalents (TEQ) C1

Appendix D: Brief Description of OTR's for Inclusion in Reports D1

Appendix E: Members of the OTR Committee E1

Appendix F: Glossary of Terms and Abbreviations F1

Appendix G: OTR Sampling Regions G1

Appendix H: References H1

Table of Figures

6.1.1: Aluminum in Class 1 Soil 16
6.1.2: Antimony in Class 1 Soil 17
6.1.3: Arsenic in Class 1 Soil 18
6.1.4: Barium in Class 1 Soil 19
6.1.5: Beryllium in Class 1 Soil 20
6.1.6: Boron in Class 1 Soil 21
6.1.7: Cadmium in Class 1 Soil 22
6.1.8: Calcium in Class 1 Soil 23
6.1.9: Chromium in Class 1 Soil 24
6.1.10: Chromium +6 in Class 1 Soil 25
6.1.11: Chloride in Class 1 Soil 26
6.1.12: Cobalt in Class 1 Soil 27
6.1.13: Copper in Class 1 Soil 28
6.1.14: Cyanide in Class 1 Soil 29
6.1.15: Cyanide in Class 1 Soil (Cont.) 30
6.1.16: Fluoride in Class 1 Soil 31
6.1.17: Iron in Class 1 Soil 32
6.1.18: Lead in Class 1 Soil 33
6.1.19: Magnesium in Class 1 Soil 34
6.1.20: Manganese in Class 1 Soil 35
6.1.20: Manganese in Class 1 Soil 36
6.1.21: Mercury in Class 1 Soil 37
6.1.22: Molybdenum in Class 1 Soil 38
6.1.23: Nickel in Class 1 Soil 39
6.1.24: Nitrate+Nitrite in Class 1 Soil 40
6.1.25: Nitrate+Nitrite in Class 1 Soil (Cont.) 41
6.1.26: Nitrogen, Total Kjeldahl in Class 1 Soil 42
6.1.27: Phosphorus in Class 1 Soil 43
6.1.28: Phosphorus in Class 1 Soil (Cont.) 44
6.1.29: Potassium in Class 1 Soil 45
6.1.30: Selenium in Class 1 Soil 46
6.1.31: Silver in Class 1 Soil 47
6.1.32: Silver in Class 1 Soil (Cont.) 48
6.1.33: Sodium in Class 1 Soil 49
6.1.34: Strontium in Class 1 Soil 50
6.1.35: Sulphur in Class 1 Soil 51
6.1.36: Thalium in Class 1 Soil 52
6.1.37: Titanium in Class 1 Soil 53
6.1.38: Uranium in Class 1 Soil 54
6.1.39: Uranium in Class 1 Soil (Cont.) 55
6.1.41: Vanadium in Class 1 Soil 56
6.1.41: Zinc in Class 1 Soil 57
6.1.42: Conductivity 25C in Class 1 Soil 58
6.1.43: pH in Class 1 Soil 59
6.1.44: SAR in Class 1 Soil 60
6.1.45: Benzene in Class 1 Soil 61
6.1.46: Benzene in Class 1 Soil (Cont.) 62
6.1.47: Ethylbenzene in Class 1 Soil 63
6.1.48: Ethylbenzene in Class 1 Soil (cont.) 64

6.1.49: Styrene in Class 1 Soil 65
6.1.50: Toluene in Class 1 Soil 66
6.1.51: m and p Xylene in Class 1 Soil 67
6.1.52: o-Xylene in Class 1 Soil 68
6.1.53: Xylene (total) in Class 1 Soil 69
6.1.54: Acenaphthene in Class 1 Soil 70
6.1.55: 5-Nitro acenaphthene in Class 1 Soil 71
6.1.56: Acenaphthylene in Class 1 Soil 72
6.1.57: Acenaphthylene (cont.) 73
6.1.58: Anthracene in Class 1 Soil 74
6.1.59: Benzo(a)anthracene in Class 1 Soil 75
6.1.60: Dibenzo(a,h)anthracene in Class 1 Soil 76
6.1.61: Camphene in Class 1 Soil 77
6.1.62: Chrysene in Class 1 Soil 78
6.1.63: Fluoranthene in Class 1 Soil 79
6.1.64: Fluorene in Class 1 Soil 80
6.1.65: Benzo(b)fluoranthene in Class 1 Soil 81
6.1.66: Benzo(k)fluoranthene in Class 1 Soil 82
6.1.67: Indole in Class 1 Soil 83
6.1.68: Naphthalene in Class 1 Soil 84
6.1.69: 1-Chloronaphthalene in Class 1 Soil 85
6.1.70: 2-Chloronaphthalene in Class 1 Soil 86
6.1.71: 1-Methylnapthalene in Class 1 Soil 87
6.1.72: 2-Methylnapthalene in Class 1 Soil 88
6.1.73: Perylene in Class 1 Soil 89
6.1.74: Benzo(g,h,i)perylene in Class 1 Soil 90
6.1.75: Phenanthrene in Class 1 Soil 91
6.1.76: Pyrene in Class 1 Soil 92
6.1.77: Benzo(a)pyrene in Class 1 Soil 93
6.1.78: Indeno(1,2,3-cd)pyrene in Class 1 Soil 94
6.1.79: Chlorbenzene in Class 1 Soil 95
6.1.80: Chlorobenzene in Class 1 Soil (cont.) 96
6.1.81: 1,2-Dichlorobenzene in Class 1 Soil 97
6.1.82: 1,3-Dichlorobenzene in Class 1 Soil 98
6.1.83: 1,4-Dichlorobenzene in Class 1 Soil 99
6.1.83: 1,4-Dichlorobenzene in Class 1 Soil 100
6.1.84: Bromomethane in Class 1 Soil 101
6.1.85: Bromomethane in Class 1 Soil (cont.) 102
6.1.86: Dibromochloromethane in Class 1 Soil 103
6.1.87: Ethylene dibromide in Class 1 Soil 104
6.1.88: Bromoform in Class 1 Soil 105
6.2.89: Bromoform in Class 1 Soil (cont.) 106
6.1.90: Chloromethane in Class 1 Soil 107
6.1.91: Methylene Chloride in Class 1 Soil 108
6.1.92: Methylene Chloride in Class 1 Soil (cont.) 109
6.1.93: Chloroform in Class 1 Soil 110
6.1.94: Trichlorofluoromethane in Class 1 Soil 111
6.1.95: Trichlorofluoromethane in Class 1 Soil (cont.) 112
6.1.96: Carbon tetrachloride in Class 1 Soil 113
6.1.97: 1,1-Dichloroethane in Class 1 Soil 114
6.1.98: Ethylene Dichloride in Class 1 Soil 115
6.1.99: 1,1,2-Trichloroethane in Class 1 Soil 116

6.1.100: 1,1,1-Trichloroethane in Class 1 Soil 117
6.1.101: 1,1,1-Trichloroethane (cont.) 118
6.1.102: 1,1,2,2-Tetrachloroethane in Class 1 Soil 119
6.1.103: Vinyl Chloride in Class 1 Soil 120
6.1.104: 1,1-Dichloroethylene in Class 1 Soil 121
6.1.105: 1,1 Dichloroethylene in Class 1 Soil (cont.) 122
6.1.106: Trans 1,2-Dichloroethylene in Class 1 Soil 123
6.1.107: Trichloroethlyene in Class 1 Soil 124
6.1.108: Trichloroethylene (cont.) 125
6.1.109: Tetrachloroethylene in Class 1 Soil 126
6.1.110: 1,2-Dichloropropane in Class 1 Soil 127
6.1.111: cis-1,3-Dichloropropylene in Class 1 Soil 128
6.1.112: trans-1,3-Dichloropropylene in Class 1 Soil 129
6.1.113: Phenol in Class 1 Soil 130
6.1.114: m-Cresol in Class 1 Soil 131
6.1.115: o-Cresol in Class 1 Soil 132
6.1.116: p-Cresol in Class 1 Soil 133
6.1.117: 4,6-Dinitro-o-cresol in Class 1 Soil 134
6.1.118: 2-Chlorophenol in Class 1 Soil 135
6.1.119: 2,4-Dichlorophenol in Class 1 Soil 136
6.1.120: 2,6-Dichlorophenol in Class 1 Soil 137
6.1.121: 2,3,4-Trichlorophenol in Class 1 Soil 138
6.1.122: 2,3,5-Trichlorophenol in Class 1 Soil 139
6.1.123: 2,4,5-Trichlorophenol in Class 1 Soil 140
6.1.124: 2,4,6-Trichlorophenol in Class 1 Soil 141
6.1.125: 2,3,4,5-Tetrachlorophenol in Class 1 Soil 142
6.1.126: 2,3,4,6-Tetrachlorophenol in Class 1 Soil 143
6.1.127: 2,3,5,6-Tetrachlorophenol in Class 1 Soil 144
6.1.128: Pentachlorophenol in Class 1 Soil 145
6.1.129: 4-Chloro-3-methylphenol in Class 1 Soil 146
6.1.130: 2,4-Dimethylphenol in Class 1 Soil 147
6.1.131: 4-Nitrophenol in Class 1 Soil 148
6.1.132: 2,4-Dinitrophenol in Class 1 Soil 149
6.1.133: Aldrin in Class 1 Soil 150
6.1.134: Carbaryl in Class 1 Soil 151
6.1.135: a-Chlordane in Class 1 Soil 152
6.1.136: g-Chlordane in Class 1 Soil 153
6.1.137: OP-DDT in Class 1 Soil 154
6.1.138: PP-DDT in Class 1 Soil 155
6.1.139: DDT in Class 1 Soil 156
6.1.140: 2,4-D in Class 1 Soil 157
6.1.141: Diazinon in Class 1 Soil 158
6.1.142: Dieldrin in Class 1 Soil 159
6.1.143: Endrin in Class 1 Soil 160
6.1.144: Heptachlor in Class 1 Soil 161
6.1.145: Heptachlor epoxide in Class 1 Soil 162
6.1.146: Lindane in Class 1 Soil 163
6.1.147: Methoxychlor in Class 1 Soil 164
6.1.148: Methyl Parathion in Class 1 Soil 165
6.1.149: Parathion in Class 1 Soil 166
6.1.150: Silvex in Class 1 Soil 167
6.1.151: Toxaphene in Class 1 Soil 168

6.1.152: Chlorobiphenyl in Class 1 Soil 169
6.1.153: 2-Dichlorobiphenyl in Class 1 Soil 170
6.1.154: Trichlorobiphenyl in Class 1 Soil 171
6.1.155: Tetrachlorobiphenyl in Class 1 Soil 172
6.1.156: Pentachlorobiphenyl in Class 1 Soil 173
6.1.157: Hexachlorobiphenyl in Class 1 Soil 174
6.1.158: Heptachlorobiphenly in Class 1 Soil 175
6.1.159: Octachlorobiphenyl in Class 1 Soil 176
6.1.160: Nonachlorobiphenyl in Class 1 Soil 177
6.1.161: Decachlorobiphenyl in Class 1 Soil 178
6.1.162: Total PCB in Class 1 Soil 179
6.1.163: Tetrachloro dibenzofuran in Class 1 Soil 180
6.1.164: Pentachloro dibenzofuran in Class 1 Soil 181
6.1.165: Hexachloro dibenzofuran in Class 1 Soil 182
6.1.166: Heptachloro dibenzofuran in Class 1 Soil 183
6.1.167: Octachloro dibenzofuran in Class 1 Soil 184
6.1.168: Tetrachloro dibenzodioxin in Class 1 Soil 185
6.1.169: Pentachloro dibenzodiozin in Class 1 Soil 186
6.1.170: Hexachloro dibenzodioxin in Class 1 Soil 187
6.1.171: Heptachloro dibenzodioxin in Class 1 Soil 188
6.1.172: Octachloro dibenzodioxin in Class 1 Soil 189
6.1.173: 2,3,7,8 Tetradioxin in Class 1 Soil 190
6.1.174: 2,3,7,8 Toxic Equivalent in Class 1 Soil 191
Figure G1: Map of OTR Sampling Regions G2

Table of Tables

Table 4.3.1: Inorganic Analytical Parameters 10
Table 4.3.2: Organic Analytical Parameters 11
Table 7.1.a: SumSummary of Inorganics in Class 1 Soils 193
Table 7.1.b: Summary of Monocyclic Aromatics in Class 1 Soil 201
Table 7.1.c: Summary of PAHs in Class 1 Soils 202
Table 7.1.d: Summary of Halogenated Cyclics in Class 1 Soils 204
Table 7.1.e: Summary of Halogenated Aliphatics Class 1 Soil 205
Table 7.1.f: Summary of Phenolics in Class 1 Soil 207
Table 7.1.g: Summary of Pesticides in Class 1 Soils 209
Table 7.1.h: Summary of PCBs in Class 1 Soils 211
Table 7.1.1: Summary of Dioxins/Furans in Class 1 Soils 212
Table A1: Confidence Intervals for OTR98s A2
Table B1: Inorganic Test Parameters Information for Soil B2
Table B2:Inorganic Test Parameter Information for Vegetation B3
Table B3: Inorganic Test Parameter Information for Snow B4
Table B1: Organic Test Parameters Information for Soil B5
Table G1: Counties that Make Up OTR Sampling Regions. G1

Section 1 Background

The Phytotoxicology Section of the Air Resources Branch, Ontario Ministry of the Environment (MOE), in concert with the associates from the Northeastern and Northwestern Regions, recognized in 1971 a need to establish contaminant concentration guidelines for interpretation of environmental data. Utilizing the results of chemical analyses and available toxicological information, guidelines termed "Concentrations Considered Excessive" were developed for a number of contaminants in soil and plant foliage. These guidelines were utilized in Phytotoxicology investigations, with periodic revisions as deemed appropriate, notably in 1978 and 1982.

By early 1983, it became apparent that the processes by which the Phytotoxicology guidelines had been established to date, were less than satisfactory because they varied among contaminants, were too subjective, and could not be supported by any consistent procedure or mathematical model.

After discussion among Phytotoxicology and Regional staff, it was agreed that new guidelines should be developed, which would have a consistent mathematical basis, and which would serve as levels which, if exceeded, would prompt further investigation on a case-by-case basis to determine the significance, if any, of the above-normal concentration(s). To this end, efforts were directed toward assembling a data base of analytical results for environmental samples collected from "background: (i.e. non-point source-contaminated) areas of Ontario".

A committee with Air Resources Branch and Regional representatives was established to examine this issue. The committee proceeded along the lines previously initiated, and developed "Upper Limit of Normal" (ULN) contaminant guidelines for terrestrial samples collected in Ontario. The ULN Guideline document was published in March, 1989 (4).

In addition to their intended use as reference data for interpretation of Phytotoxicology investigations, the ULN guidelines, for soil, have also been incorporated in the Guidelines For The Decommissioning and Cleanup of Sites in Ontario(5) and in several other MOE guidelines.

The increased and often inconsistent use of the ULN guidelines in other MOE guidelines and by other agencies and the lack of a formal review and maintenance process were identified by the MOE Materials Policy Committee (personal communication) as issues that warranted a full re-evaluation of the ULN process. Accordingly, a committee, with representatives from the Phytotoxicology Section and the Northeastern and Northwestern Regions, was established in the spring of 1990 to completely re-evaluate the ULN guidelines.

The committee found that while the ULN guidelines were significantly better than the previous "Concentrations Considered Excessive", there were problems that needed to be resolved. These problems were related to the purpose for which the guidelines had originally been developed, the land use categories, the sample categories and the model used in developing the ULN guidelines. Rather than trying to correct the problems, the committee recommended that the ULN guidelines be replaced with a new set of guidelines.

As the new guidelines were to be significantly different from the ULN guidelines a new name, "**Ontario Typical Range** of Chemical Parameters in Soil, Vegetation, Moss Bags and Snow" or "OTR", was chosen. The word "typical" does not imply acceptable the way "normal" did in the ULN's. "Ontario" is included in the name to indicate that the data used are only from the Ontario region. The use of "range", instead of upper limit, better reflects the new model on which the OTR's are based and how the guidelines are to be interpreted.

The OTR's are based on more and better-defined land use categories, more-specific receptor types and a model that can handle the non parametric data in the database. The new guidelines will serve the primary purpose of providing scientifically valid reference data for interpretation of phytotoxicological investigations. They also will provide other Ontario Ministry of Environment and Energy (OMOEE) users with a comprehensive background assessment protocol that will assist in multimedia standards setting , risk assessment, site clean-up and decommissioning, and in the development of background based chemical classification guidelines for materials management. The OTR's will be phased in, starting in 1993, as the data become available.

Section 2 Ontario Typical Range Model

There are problems with the model originally used to define the Upper Limit of Normal. The use of the mean plus three standard deviations (99.9% of the population) is not valid when the sample population is not normally distributed. As many of the data sets used were not normally distributed, the ULN guidelines determined by this method did not really represent 99.9% of the population. The second problem is the size of sample set used. Work has shown that for soils in Ontario, the number of samples needed to be within 10% of the mean 90% of the time, ranges between 100 and 200 samples. Analysis of the data originally used to develop the ULN guidelines showed that using the same 10%/90% limits, the average number of samples needed would be 247.. The use of 30 samples (previous minimum) could result in very poor estimates of both the mean and standard deviation for many of the ULN values.

Because of the non-normally distributed nature of many of the parameters for which OTR's are to be developed, only non-parametric statistics will be used in the OTR model. The model for the new OTR will be based on the actual distribution of the data for each parameter/receptor/land use combination. The actual distribution was chosen over the range or minimum and maximum as the distribution will give the investigator more information on which to interpret results.

In addition to the OTR distribution, a value referred to as the OTR_{98} will exist for each parameter/receptor/land use combination. The OTR_{98} will be a value that represents the 97.5 percentile of the sample population. The 97.5 percentile was chosen as it is equivalent to the mean plus two standard deviations of a normally distributed population. The equivalent of two standard deviations was used instead of the three standard deviations used in the ULN guidelines, as it was felt that it was not possible to guarantee that all of the data in a distribution are true controls. By excluding the upper 2.5 percent of the distribution, most potential outliers should be excluded. The OTR_{98} value will be similar to the ULN value and can be used in a similar manner.

Unlike the ULN's there will be no minimum number of samples, based on statistical requirements, in order for a OTR to be developed. Putting arbitrary limits on whether there is sufficient data to describe a distribution would result in valuable data not being used. Instead, the confidence limits around the OTR_{98} will be determined for each OTR distribution using the methods for Distribution-Free Confidence Intervals for Quantiles as described by David (10) (see Appendix A1: for a detailed description of the method). In addition, the average within site sampling variability and analytical error ($\bar{x}CV$) around the OTR_{98} will be determined. It will be up to each individual user of the OTR's and OTR_{98}'s to take the confidence limits and sampling error estimates into account when applying these numbers in the interpretation of either field results or when using the OTR's as the basis for other guidelines.

The data used to develop each OTR guideline will have to represent all the OTR Sampling Regions (see Appendix G). The OTR Sampling Regions are equivalent to the pre August 1, 1993 OMOEE Regions. To ensure a minimum spatial distribution of data across the province the number of data points from any one region must be ≥10% and ≤30% of all the data in the distribution. In some cases, a receptor may not occur in a region, in which case, this will be noted and the OTR guideline will not apply to that Region.

There will be certain conditions under which provisional OTR's will be developed. The provisional OTR_{98} will be referred to as the OTR_{98P}. The conditions under which provisional OTR's are developed are:

- When there are enough data above the detection limit to determine the OTR_{98} but not enough to determine the confidence limits around the OTR_{98}.
- When all of the data are below the detection limit. In this special case the OTR_{98P} will be set at less than the detection limit.

Each datum point in an OTR distribution will represent a sample station. There will have to be a minimum of two samples collected from a station for that station to be included in an OTR distribution. Samples for a given station do not necessarily have to be collected on the same date. The average of all the sample results from a station will be used. When calculating the average value for each sampling station, a result qualified as <T will be used as reported and a result qualified as <W or < will be halved (see Appendix F: for definition of <W and <T). A station must be in the Station Description File (SDF) on the OMOEE Sample Information System (SIS) database to be included in an OTR distribution. In addition, each station must be a Control Sample Station (not influenced by a point source) for that land use category, as defined by the Phytotoxicology Field Investigation Manual (6).

As a significant portion of the OTR data will come from the re-analysis of archived samples, limits have to be placed on the number of samples used in order to minimize test loads. If a site was sampled in more than two years and replicate samples were collected in each year, then only one sample from each year, for a maximum of five years, will be used. If there is only one to two years of samples, then duplicates for each year will be used. Where there is insufficient sample in one replicate, the replicate samples for that collection date may be combined. For archived samples, a site is defined as one where all samples were collected within a 100 m radius.

It is the policy of the OTR Work Group that the number OTR's developed be kept to a minimum. This will be done by combining receptor/land use data sets in a statistically defensible manner. When it is determined that there is no significant difference between the distributions for two or more receptor types and/or land use categories for a given test parameter, the distributions will be combined into one and be identified as such. If it is determined that there are significant differences between the distributions for a receptor type for a given test parameter due to Regional differences, then a separate OTR guideline will be developed for each Region.

The differences or similarities between distributions will be determined by using the Kolmogorov-Smirnov Two-Sample Test (see Appendix A2: for a detailed description of the test). This is a non-parametric statistical test that determines whether two distributions have the same mean, standard deviation and shape.

For interpretation purposes, all OTR's for each parameter/receptor/land use combination will be represented graphically. Each distribution will consist of a bar showing the percentile distribution, OTR$_{98}$, OTR$_{98}$ confidence limits, mean, current OMOEE <W and <T reporting limits, and a phytotoxicological threshold level (if referenced ones exist). All the land use categories for each parameter/receptor will be included in one graph. A more detailed description of the graphical representation is given in Appendix A4:

Section 3 Use Categories/Receptors/Parameters

The sections below describe ten land use categories, 19 possible receptor types and 167 test parameters that will be used in developing OTR's. The potential number of OTR's that can be developed when combined using these categories is over 7500. With ten land use categories on each graph, this will mean there will potentially be 750 pages of graphs for the fully developed OTR's. While the combining of land use categories and receptor types when no significant differences exist will reduce the total number, the amount of work involved is considerable compared to the ULN guidelines. Between 500,000 and 1,500,000 test results will be required from historical data, archived samples and newly collected samples.

3.1 Land Use Categories

The two land use categories of Rural and Urban as defined in the ULN guidelines are too broad. Land use categories that represent the different degrees of contamination due to normal human activity, past and present, are needed. The following land use categories will initially be assessed for OTR development:

URBAN	Old Urban (>40 years)	1. Residential 2. Commercial/Industrial/Transportation 3. Parkland/Greenbelt
	New Urban (<40 years)	4. Residential 5. Commercial/Industrial/Transportation 6. Parkland/Greenbelt
RURAL	7. Residential 8. Commercial/Industrial/Transportation 9. Parkland/Greenbelt 0. Agricultural	

The definition of Urban for the OTR's is not based on an arbitrary population size as it is in the ULN guidelines. Instead, Urban is defined on size and density relationship. Urban is defined as any property that is fully serviced by both municipal water and sewage systems. The requirement for water and sewer services in any community is largely determined by the size of the population and the density of the housing. It is relatively easy for an investigator to determine if the services are available. Defining Urban as areas being fully serviced by municipal water and sewage services is a common practice in the Ministry of Environment and Energy.

Urban was split into Old Urban and New Urban because many communities have been built in the last 40 years, post World War II. They have not had time to accumulate the same amounts of contaminants from normal anthropogenic activities as have the old urban areas. All areas not classed as Urban are considered Rural.

Residential property includes a dwelling and associated gardens and lawns up to the dwelling side of the sidewalk or to 3 m from the road where a sidewalk does not exist.

Commercial/Industrial/Transportation includes all properties used for industrial or commercial businesses, and all designated transportation right-of-ways. For residential roadways, this would include the 3 m road allowances. Highways would include all land between the Ministry of Transportation fence lines. For railways, it would include the land between the railway fence lines or, where fences are not used the area kept clear by the railway (sprayed/mowed). While this category will be used for evaluating samples collected from commercial, industrial and transportation land use categories, the data used to develop the OTR's will only come from samples collected in areas classed as commercial and transportation land use. It is too difficult to determine if samples collected in industrial land use areas have been affected by point sources.

Agricultural includes all land actively used as tilled or managed cropland or untilled pasture. Active is defined as land tilled or managed for crop production or grazed within the previous 25 years. Land not tilled within 25 years is considered Parkland. Field fence lines, although not tilled, are to be considered agricultural. Agricultural soil guidelines are to be for 0-15 cm, cultivated, depth (See Section 3.2.2).

Parkland is everything that is not residential, commercial/industrial, transportation rights-of-way, or active agricultural land. This would include parks, cemeteries, schools, forests or woodlots and most large undeveloped areas. Golf courses, although clearly an open space parkland type of use, have a high potential for contamination from all of the inorganic and organic pesticides and fertilizers that are use to keep the turf in acceptable condition. Therefore, golf courses will not be covered by the OTR guidelines.

The designations for Residential, Commercial/Industrial/Transportation, and Parkland/Greenbelt are the same for all three (Old Urban, New Urban and Rural) major land use categories. Agricultural only applies to Rural.

Where there is no significant difference between the distribution of data for two or more land use categories for a given receptor/parameter, the categories will be combined into one.

No OTR sampling is to be conducted in areas which can not be classified. Consequently the OTR's can not be applied to samples from unclassified land use areas.

3.2 Receptor Types

Unless otherwise stated, OTR's will be developed for the major receptor groups listed in Sections 3.2.1-3.2.3. These are essentially the same as in the ULN guidelines except that in the OTR's, the groups are further broken down into subgroups, especially in the case of vegetation. This was deemed necessary as not all receptors accumulate contaminants at the same rate and they can also have different baseline levels. Where no significant differences are found between groups, the data will be combined into one OTR covering both groups.

Due to the large number of sample types and land use categories for which OTR's are to be developed, they will created on a priority basis. The order of priority will be determined by examining the historical data to determine what sample types were collected most frequently and what land use categories were sampled most.

3.2.1 Vegetation

Combining different species into one ULN and then applying that ULN to all species is not acceptable because there are distinct differences between species or families in the amount of chemical accumulation/retention that occurs. OTR's for the following most commonly collected sample types will be developed initially:

Deciduous[a] Foliage	1) maple[1]
	2) birch[1]
	3) aspen/poplar[1]
	4) ash[1]
	5) alder[2] (NE & NW only)
	6) hazel[3] (NE & NW only)
Coniferous[b] Foliage	1) spruce[1]
	2) pine[1]
	3) cedar[4]
Grass[c]	1) green
	2) mixed
	3) dry
Lichens and Moss[d]	
Garden Vegetables	

[a]-Deciduous foliage includes the blade plus the petiole. All foliage of all ages in a shoot is to be used in the sample.

[1]-include species commonly found in Ontario.

[2]-alder include: speckled alder

[3]-hazel include: beaked hazel

[4]-cedar include: white cedar

[b]-The OTR guideline for coniferous foliage is to be developed for current year needles, with the exception of cedar (all non woody tissue), with the potential for expansion to older needles at a later time.

[c]-Green grass is classed as 90% or more of the sample being green. Senescent grass is classed as 90% or more of the sample being dry. Mixed is all other combinations of green and senescent grass. Only grasses are to be included; no sedges or rushes.

[d]-While there is a need for OTR values for lichens and mosses in the Northern Regions, further investigation as to which species should be included will have to be conducted.

Where there is no difference in the data distribution for two or more sample types for a given test parameter/land use category, these will be combined into one OTR. Conversely, if there is a significant difference between one of the species in a sample category and the rest of the species in that category for a given test parameter/land use, a separate OTR will be developed for that species/parameter/land use.

The OTR's will only use data from unwashed samples. For washed samples, control samples should be taken for comparative purposes.

Tentatively, the OTR's for deciduous and coniferous foliage and grass can only be applied to foliage collected between June 15 and September 15 for the Southern Regions and June 30 and September 1 for the Northern Regions of Ontario. A study will be conducted to determine what, if any, changes occur in all test parameters over the growing season in a number of deciduous and coniferous tree species. Other seasonal limits may be placed on specific species and/or test parameters if required.

A review of the 1987 SIS records showed that garden vegetables are the fifth most commonly collected receptor type for chemical analysis by the Phytotoxicology Section. OTR's will be developed for garden vegetables after a thorough analysis of the SIS records from 1981 to 1990 to determine which of the many garden vegetables require OTR's. OTR's for garden vegetables will be limited to the three residential land use categories and possibly the Urban Parkland category.

3.2.2 Soil

OTR's for soil will only apply to the 0-5 cm depth, except for tilled areas (gardens and fields), 0-15 cm depth. Guidelines for the following three soil classes will be developed.

Soils Class
1. All soils that are not Class 2 or 3 soils as defined below.
2. Organic carbon content >17% by dry weight.
3. Loamy Sand and Sand soils as defined in (11).
   (sand content >85% by dry weight, or for sand content between 70 and 85%, clay < %sand - 70% by dry weight)

Clay and sand content is determined in the field by each investigator using the standard "Finger Assessment of Soil Texture" method (11). Organic content is determined by loss on ignition (27).

Due to the different ability of these soil classes to retain contaminants, there is a potential for significant differences between these three soil types. Further study will determine the actual significance. Initially, all existing soil data and archived samples, 0-5 cm, will be used and considered as being in Soil Class 1.

3.2.3 Snow

OTR's for snow samples will be developed for the Northeastern and Northwestern Regions only. These will apply to snow samples collected using the standard Phytotoxicology technique (6) in which the entire snow profile is collected. The OTR will be expressed on the weight per volume basis (mg/l) as used in the ULN guidelines.

3.2.4 Moss Bags

There are potential problems with developing OTR's for moss bags. The major problem is that the background level of a number of elements can vary significantly with the source of the moss. Thus, each new batch of moss may have a different starting level. As the exposed control moss bag accumulation is small, significant differences between batches can greatly affect the OTR guideline. There also may be problems in the interpretation of any data from moss bags that come from batches not included in the OTR. The other problem is that, for some elements, the level in exposed control bags is often lower than unexposed bags.

As moss bags make up a significant portion of the samples collected annually, OTR's will eventually be developed for moss bags. More work will have to be done to eliminate or minimize the above problems. OTR's for moss bags, when developed, will be for one month (30 days) exposures and only for those elements where there are no significant differences between batches. OTR's for moss bags, when developed, will be limited to Urban and Rural land use categories and not the subcategories belows these.

3.3 Analytical Parameters

The inorganic analytical parameters for which OTR's will be developed (vegetation, soil, moss bags and snow) are given in Table 4.3.1. OTR's may be developed for selected radionuclides for certain sample types if suitable data become available (i.e. from a Federal/Provincal cooperative study).

Because of the high cost of organic analysis and the potentially large number of organic compounds, OTR's will only be developed where there is a demonstrated need. At this time, OTR's for organic compounds will only be developed for Soil Class 1 in Rural and Old Urban Parkland land use category as part of the Ministry's Material Policy. The organic analytical parameters for which OTR's will be developed (Soil Class 1) are given in Table 4.3.2.

For reference purposes, the instrumentation, sample digestion and/or preparation and the minimum sample weight currently used by the Laboratory Services Branch, Inorganic Trace Contaminants Section, for each test are also given in Appendix B: for inorganic test parameters. All samples collected for OTR's should have four times the minimum weight required for analysis. This will allow enough sample for re-analysis by the laboratory and for archiving of the sample for future analysis.

Request for analysis group codes have been set up on the Laboratory Information System (LIS) for samples to be analyzed for the OTR parameters. OTRV is the test code for all vegetation samples, OTRS is the test code for all soil samples, OTRMB is the test code for moss bags and OTRSN is the test code for all snow samples. In addition to the parameters for soil listed in Table 1, loss on ignition (a test for organic carbon content) will also be included in the OTRS group code. The sand content of soil samples will be determined by the field investigator using the standard field test technique(11).

Table 4.3.1: Inorganic Analytical Parameters for Which OTR's Will be Developed for Soil, Vegetation, Moss Bags, and Snow

Test Parameter	Vegetation Foliage & Grass	Soils 0-5 cm	Snow	Moss Bags
Aluminum	X	X	X	X
Antimony	X	X	X	X
Arsenic	X	X	X	X
Barium	X	X	X	X
Beryllium	X	X	X	X
Boron	X	X		X
Cadmium	X	X	X	X
Calcium	X	X	X	X
Chloride	X	X	X	X
Chromium	X	X	X	X
Chromium (VI)		X[c]		
Cobalt	X	X	X	X
Copper	X	X	X	X
Cyanide		X[c]		
Fluoride	X	X	X	X
Iron	X	X	X	X
Lead	X	X	X	X
Magnesium	X	X	X	X
Manganese	X	X	X	X
Mercury	X	X	X	X
Molybdenum	X	X	X	X
Nickel	X	X	X	X
Nitrate+Nitrite		X[c]		
Total Nitrogen	X	X	X[a]	
Total Phosphorus	X	X	X	
Total Potassium	X	X	X	
Selenium	X	X	X	X
Silver	X	X		X
Sodium	X	X	X	X
Strontium	X	X		X
Sulphur	X	X	X[b]	X
Thallium	X	X		X
Titanium	X	X	X	X
Uranium	X	X	X	X
Vanadium	X	X	X	X
Zinc	X	X	X	X
SAR		X[c]		
pH		X[c]		
Conductivity		X[c]	X	
Suspended Solids			X	
Dissolved Solids			X	
Total Solids			X	
DOC			X	
DIC			X	
PTC			X	
Lignins			X	
Tannins			X	

a - nitrogen as nitrate, b - sulphur as sulphate, c - Parkland Land Use/Class 1 Soils only

DIC - Dissolved Inorganic Carbon, DOC - Dissolved Organic Carbon, PTC - Particulate Total Carbon

Table 4.3.2: Organic Analytical Parameters for Which OTR's Will be Developed

Test Parameter	Vegetation Foliage & Grass	Soils 0-5 cm	Snow
Monocyclic Aromatics			
Benzene		X[c]	
Ethylbenzene		X[c]	
Styrene		X[c]	
Toluene		X[c]	
o-Xylene		X[c]	
m/p-Xylene		X[c]	
Xylene		X[c]	
Polycyclic Aromatics			
Acenaphthene		X[c]	
5-Nitro acenaphthene		X[c]	
Acenapthylene		X[c]	
Anthracene		X[c]	
Benzo(a)anthracene		X[c]	
Dibenz(a,h)anthracene		X[c]	
Camphene		X[c]	
Chrysene		X[c]	
Fluoranthene		X[c]	
Benzo(b)fluoranthene		X[c]	
Benzo(k)fluoranthene		X[c]	
Fluorene		X[c]	
Indole		X[c]	
Napthalene		X[c]	
1-Chloronapthalene		X[c]	
2-Chloronapthalene		X[c]	
1-Methyl napthalene		X[c]	
2-Methyl napthalene		X[c]	
Perylene		X[c]	
Benzo(ghi)perylene		X[c]	
Phenanthrene		X[c]	
Pyrene		X[c]	
Benzo(a)pyrene		X[c]	
Indeno(1,2,3-cd)pyrene		X[c]	
Halogenated Cyclics			
Chlorobenzene		X[c]	
1,2-Dichlorbenzene		X[c]	
1,3-Dichlorbenzene		X[c]	
1,4-Dichlorbenzene		X[c]	
Halogenated Aliphatics			
Bromomethane		X[c]	
Dibromochloromethane		X[c]	
Ethylene dibromide		X[c]	
Tribromomethane		X[c]	
Chloromethane		X[c]	
Dichloromethane		X[c]	
Trichloromethane		X[c]	
Trichlorofluoromethane		X[c]	
Carbon Tetrachloride		X[c]	

c - Parkland Land Use/Class 1 Soils only

Table 4.3.2.b: Organic Analytical Parameters Continued

Test Parameter	Vegetation Foliage & Grass	Soils 0-5 cm	Snow
Halogenated Aliphatics	**(Continued)**		
1,1-Dichloroethane		X^c	
1,2-Dichloroethane		X^c	
1,1,2-Trichloroethane		X^c	
1,1,1-Tricholorethane		X^c	
1,1,2,2-Tetrachloroethane		X^c	
Chloroethylene		X^c	
1,1-Dichloroethylene		X^c	
trans 1,2-Dichloroethylene		X^c	
Trichloroethylene		X^c	
Tetrachloroethylene		X^c	
1,2-Dichloropropane		X^c	
cis-1,3-Dichloropropylene		X^c	
trans1,3-Dichloropropylene		X^c	
Phenolics		X^c	
m-Cresol		X^c	
o-Cresol		X^c	
p-Cresol		X^c	
4,6-Dinitro-o-cresol		X^c	
Phenol		X^c	
2-Chlorophenol		X^c	
2,4-Dichlorophenol		X^c	
2,6-Dichlorophenol		X^c	
2,3,4-Trichlorophenol		X^c	
2,3,5-Trichlorophenol		X^c	
2,4,5-Trichlorophenol		X^c	
2,4,6-Trichlorophenol		X^c	
2,3,4,5-Tetrachlorophenol		X^c	
2,3,4,6-Tetrachlorophenol		X^c	
2,3,5,6-Tetrachlorophenol		X^c	
Pentachlorophenol		X^c	
4-Chloro-3-methylphenol		X^c	
2,4-Dimethlyphenol		X^c	
4-Nitrophenol		X^c	
2,4-Dinitrophenol		X^c	
Pesticides			
Aldrin		X^c	
Carbaryl		X^c	
a-Chlordane		X^c	
g-Chlordane		X^c	
O,P-DDT		X^c	
P,P-DDT		X^c	
DDT		X^c	
2,4-D		X^c	
Diazinon		X^c	
Dieldrin		X^c	

c - Parkland Land Use/Class 1 Soils only

Table 4.3.2.c: Organic Analytical Parameters Continued

Test Parameter	Vegetation Foliage & Grass	Soils 0-5 cm	Snow
Pesticides	**(Continued)**		
Endrin		X[c]	
Heptachlor		X[c]	
Hepachlor epoxide		X[c]	
Lindane		X[c]	
Methoxychlor		X[c]	
Methyl Parathion		X[c]	
Parathion		X[c]	
Silvex		X[c]	
Toxaphene		X[c]	
PCBs			
Chlorinated Biphenyls		X[c]	
Dichlorinated Biphenyls		X[c]	
Trichlorinated Biphenyls		X[c]	
Tetrachlorinated Biphenyls		X[c]	
Pentachlorinated Biphenyls		X[c]	
Hexachlorinated Biphenyls		X[c]	
Heptachlorinated Biphenyls		X[c]	
Octachlorinated Biphenyls		X[c]	
Nonachlorinated Biphenyls		X[c]	
Decachlorinated Biphenyls		X[c]	
PCB, Total		X[c]	
Dioxins and Furans			
Tetrachlorodibenzofurans		X[c]	
Pentachlorodibenzofurans		X[c]	
Hexachlorodibenzofurans		X[c]	
Heptachlorodibenzofurans		X[c]	
Octachlorodibenzofurans		X[c]	
Tetrachlorodibenzo-p-dioxin		X[c]	
Pentachlorodibenzo-p-dioxin		X[c]	
Hexachlorodibenzo-p-dioxin		X[c]	
Heptachlorodibenzo-p-dioxin		X[c]	
Octachlorodibenzo-p-dioxin		X[c]	
2,3,7,8-Tetrachloro-p-dioxin		X[c]	
2,3,7,8-TCDD Toxic Equivalents[d]		X[c]	

---

c - Parkland Land Use/Class 1 Soils only

d- see Appendix C for the Derivation of 2,3,7,8-TCCD TEQs

Section 4 Review and Maintenance Process

Because of the scope of the OTR's, it will take a number of years to develop OTR's for all of the receptor type/land use combinations. In addition, new sample types and parameters will be added as the need arises. The OTR's will be a continually evolving set of guidelines. This will require regular meetings of the OTR committee for review and maintenance of the OTR's.

The committee will consist of one representative from the NE and NW Regions and six representatives from the Phytotoxicology Section. A minimum of half of the members should be regular field investigators to ensure that their requirements are being met.

The OTR committee will hold a series of meetings starting in the beginning of each calendar year to evaluate the data collected in the previous year for inclusion into the OTR's. The committee will also develop a work plan for the gathering of additional data for the next field season. The committee will coordinate its efforts with the Ontario Ministry of Environment and Energy Materials Policy Committee and other relevant committees.

In order to handle the regular updating of the OTR's, the Phytotoxicology Information Management System (PIMS) will be modified. PIMS will identify all new data that fit the OTR criteria and will automatically update the OTR tables and graphs at the end of each year or as appropriate. The OTR committee will be responsible for validating these changes.

Section 5 Interpretation and Application of the Typical Ontario Range

The OTR's for soil, vegetation, snow and moss bags were developed to assist in the interpretation of Phytotoxicology data. The OTR's are to assist in determining whether the level of a measured parameter in a given receptor is above that which would be anticipated for the level of anthropogenic activity in the area sampled (land use category). An exceedence of the OTR_{98} would indicate a potential source of contamination. Incidental, isolated or spurious exceedences of an OTR_{98} shall not necessarily indicate a need for regulatory or abatement activities. However, repeated and/or extensive exceedences of an OTR which can be related temporally or spatially to a source characterized by emission of such a contaminant[1] will indicate a need for a thorough evaluation of the regulatory or abatement program.

As the OTR's are a set of distributions, they can also be used to determine where, in the anticipated distribution, a result falls. This can be used to indicate a potential level for concern even when a result falls within the range.

These guidelines apply only to samples collected using standard Phytotoxicology sampling techniques(6), prepared using standard Phytotoxicology laboratory sample preparation techniques(7) and analyzed using standard OMOEE analytical techniques (12)-(47). As the OTR's are developed from data collected in Ontario, or specific regions of Ontario, they only apply to terrestrial samples collected in Ontario or a specific region of Ontario. As the OTR's are more specific than the ULN guidelines, the OTR's can not be applied to receptors other than those for which OTR's are developed. Where OTR's do not exist for a receptor, then the old ULN guidelines may be applied. However, good control[2] samples would be more appropriate.

---

[1] Contaminant as defined in Section 1.1.C of the Environmental Protection Act(11).

Due to the potentially high sampling error for some organic parameters, as compared to inorganic parameters, caution must be exercised when comparing results against the OTR_{98} for organics. It is recommended that results from single samples for organics not be compared against the OTR distribution. The average of at least duplicate, preferably triplicate, samples should be compared. In addition the coefficient of variability of the samples and of the OTR_{98} should be taken into account when making the comparisons.

At the discretion of the Investigator-In-Charge, an OTR land-use category other than that which would normally be used may be substituted. In this case, the Investigator-In-Charge must indicate that this has been done and include the reasoning for the change in the report related to the investigation.

The OTR's should not be the sole means by which results are interpreted. In interpreting results importance should be placed on the control samples that are collected and on the pattern of contamination observed in the samples. The OTR's are to assist in the assessment of source related contributions where there is some question concerning the local background samples and/or enough samples have not been collected to determine any pattern of contamination (i.e. complaint investigations).

The OTR's for each receptor/land use category assume a given range of contamination resulting from normal anthropogenic activity for that land use category. As a result, values lying within the OTR's should not necessarily be considered as acceptable concentrations nor do they imply phytotoxicity. The one potential exception in terms of 'acceptable concentrations' is for the Rural Parkland/Greenbelt/Woodlands land use category where it can be assumed that there has been minimal impact, except for long range transport, from anthropogenic sources.

Where an OTR_{98} exists for a given receptor/land use category, the OTR_{98} will supersede the ULN for the interpretation of results. If an OTR does not exist, the ULN will be used in the interim.

The use of the OTR_{98} for purposes (i.e. incorporation into other Ministry guidelines, policies or standards) other than those described above should be done with caution and with prior consultation with the Phytotoxicology Section.

Section 6 Ontario Typical Range Distributions

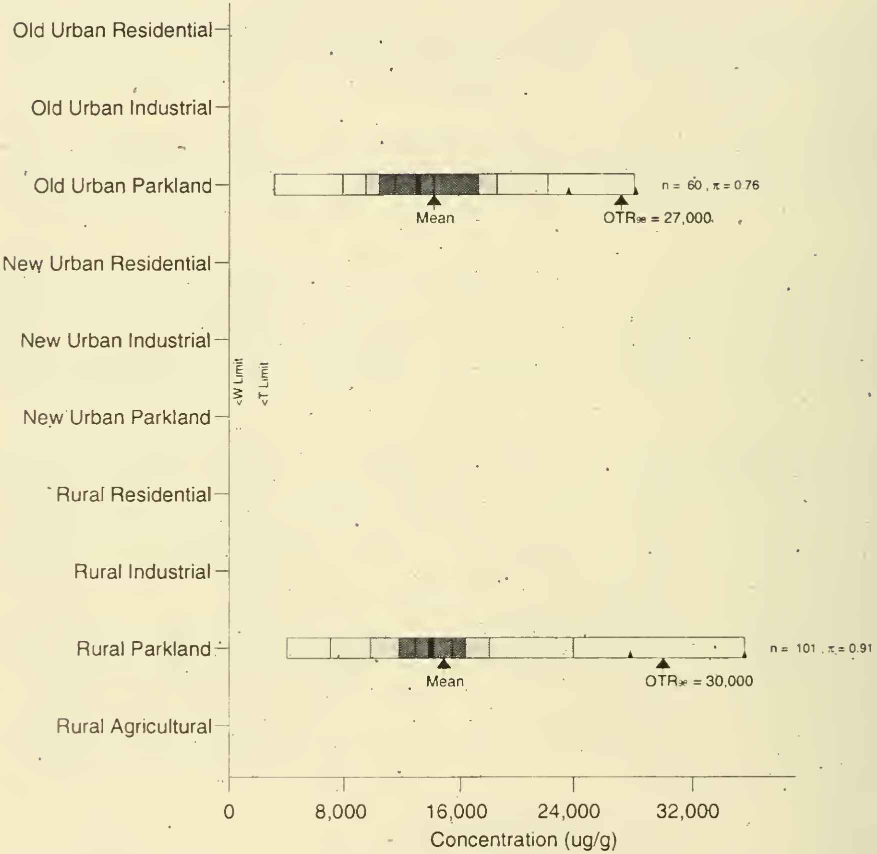
Sections 6.1 - 6.4 contain the OTR's that have been developed to date for soil, vegetation, mossbags and snow. These OTR's can only be applied to the receptor/parameter/land use indicated.

---

2 See Appendix F: Glossary of Terms and Abbreviations for a description of control as used in this document.

6.1 OTR's for Soil

Figure 6.1.1



Ontario Typical Range

Aluminum in Class 1 Soils

Figure 6.1.2

Ontario Typical Range

Antimony in Class 1 Soils

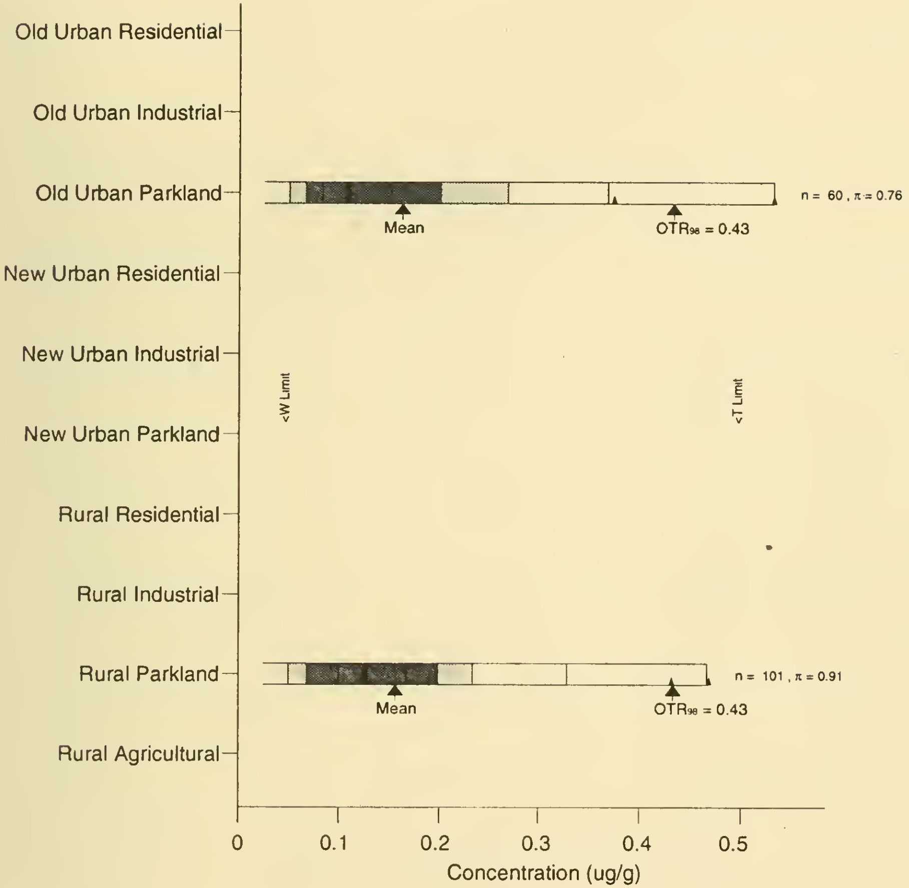


Figure 6.1.3

Ontario Typical Range

Arsenic in Class 1 Soils

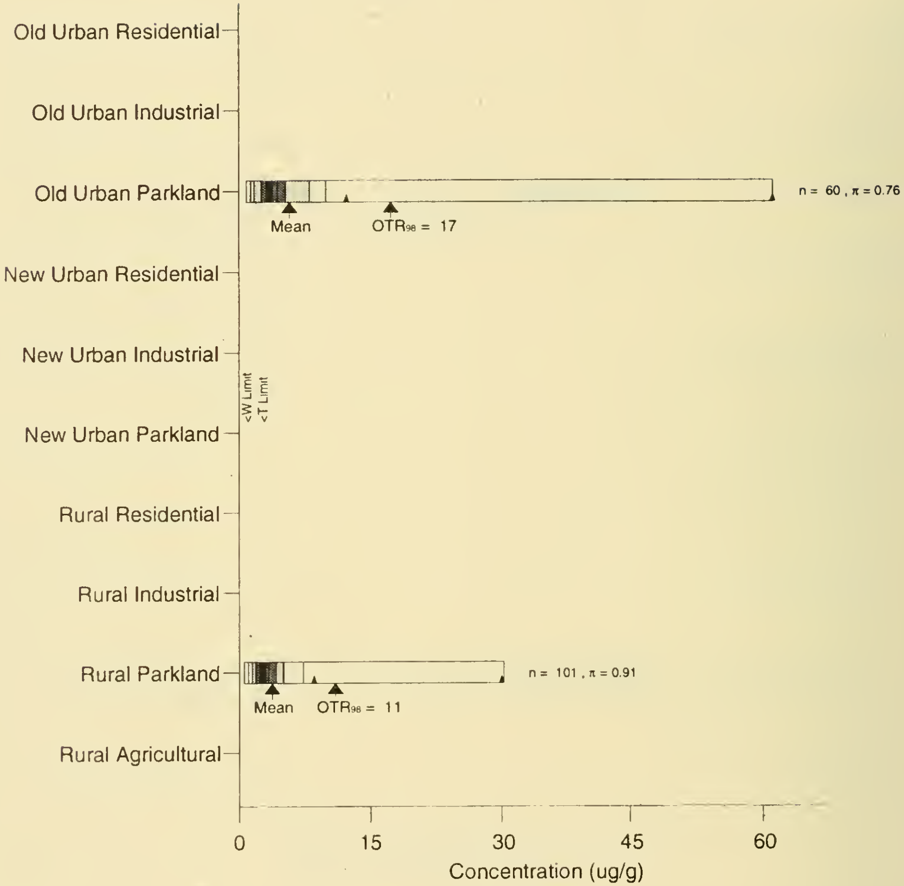


Figure 6.1.4

Ontario Typical Range

Barium in Class 1 Soils

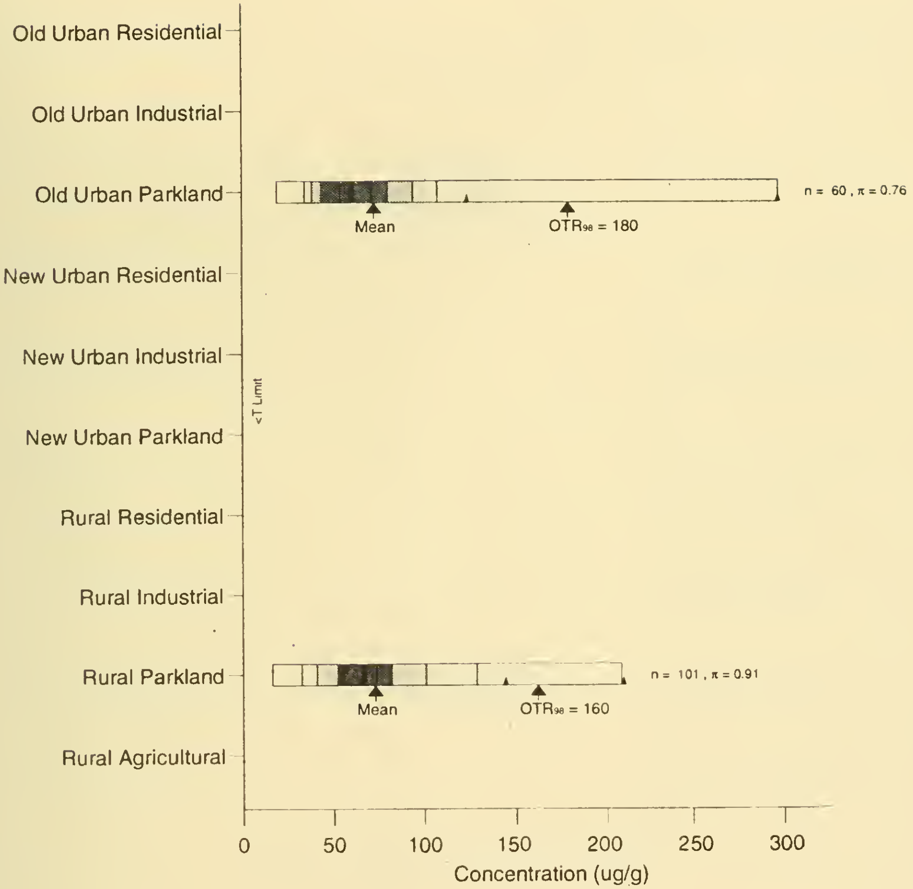


Figure 6.1.5

Ontario Typical Range

Beryllium in Class 1 Soils

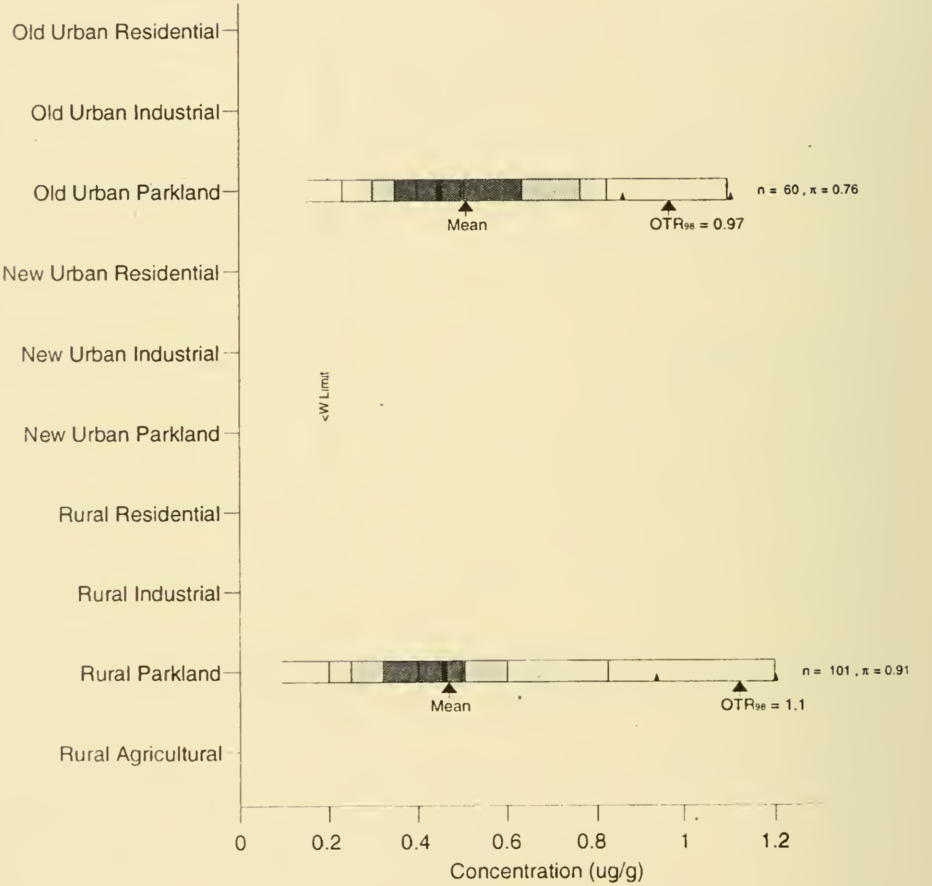


Figure 6.1.6

Ontario Typical Range

Boron in Class 1 Soils

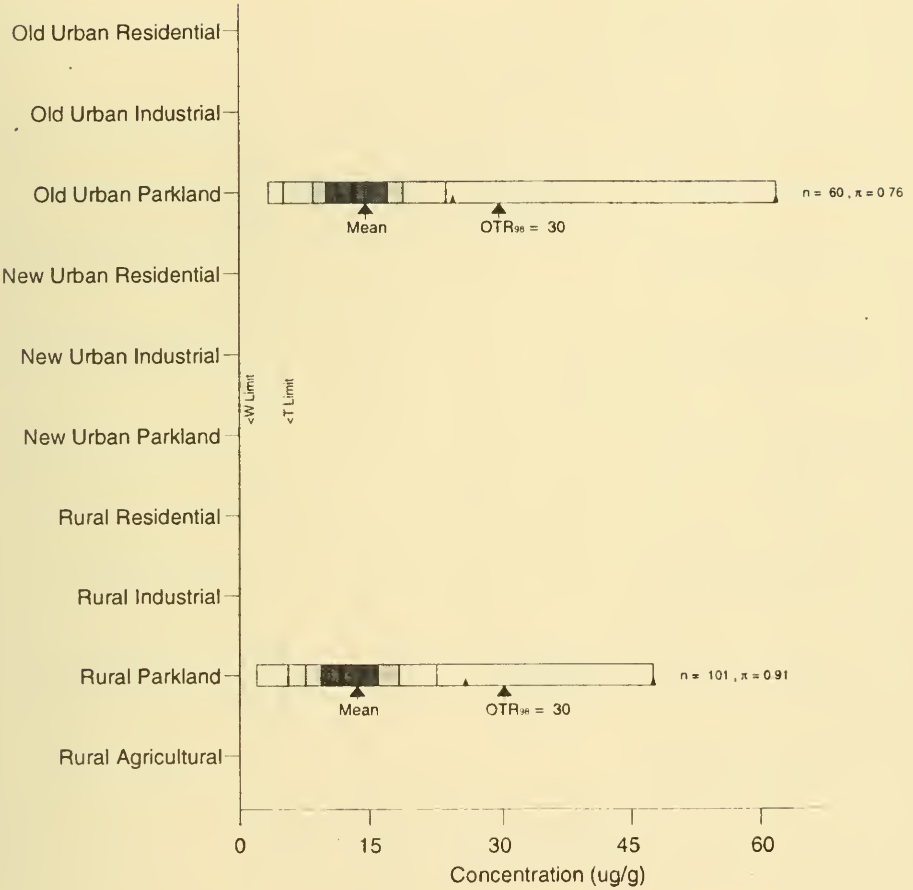


Figure 6.1.7

Ontario Typical Range

Cadmium in Class 1 Soils

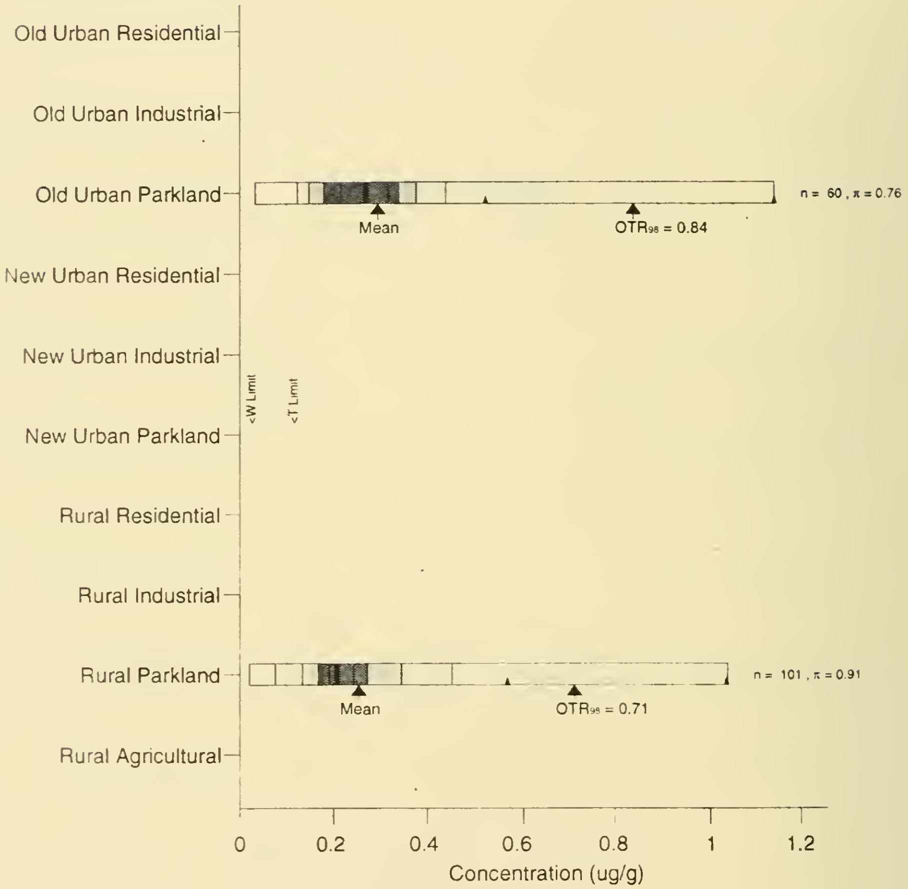


Figure 6.1.8

Ontario Typical Range

Calcium in Class 1 Soils

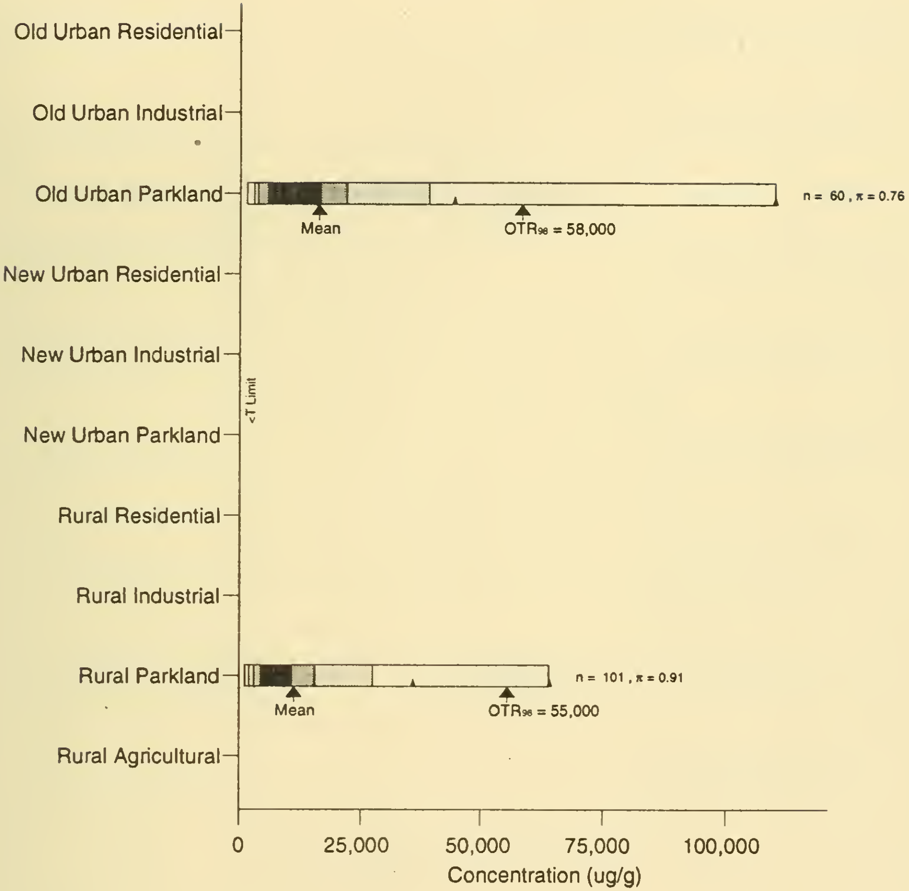


Figure 6.1.9

Ontario Typical Range

Chromium in Class 1 Soils

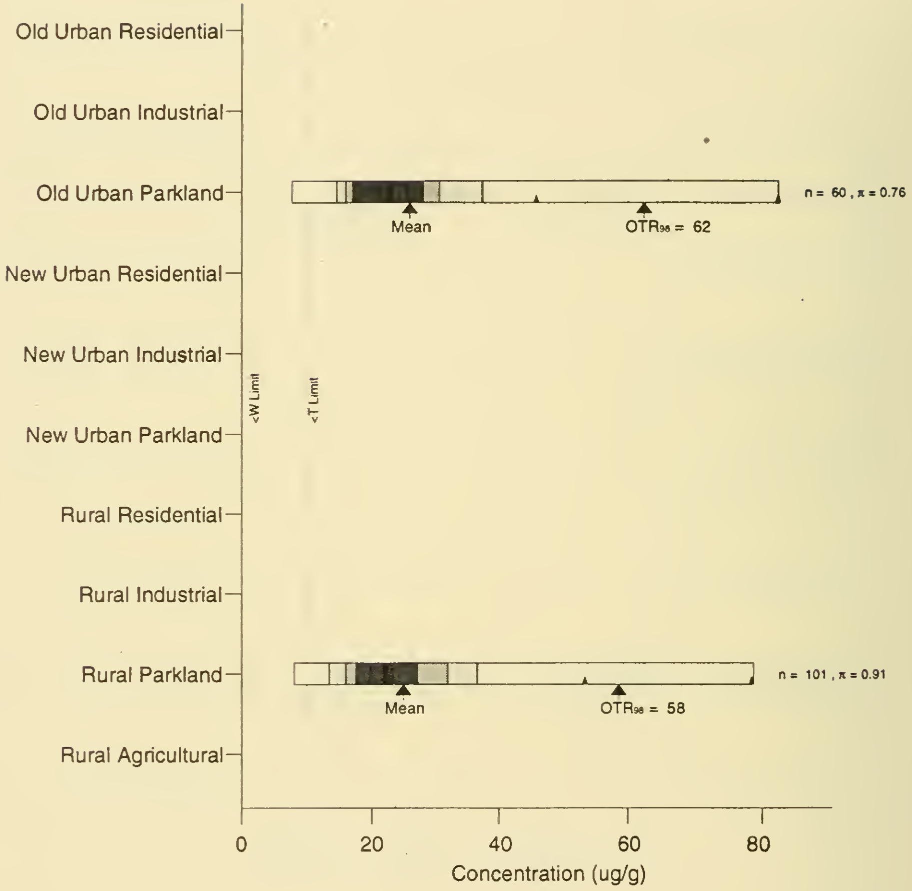
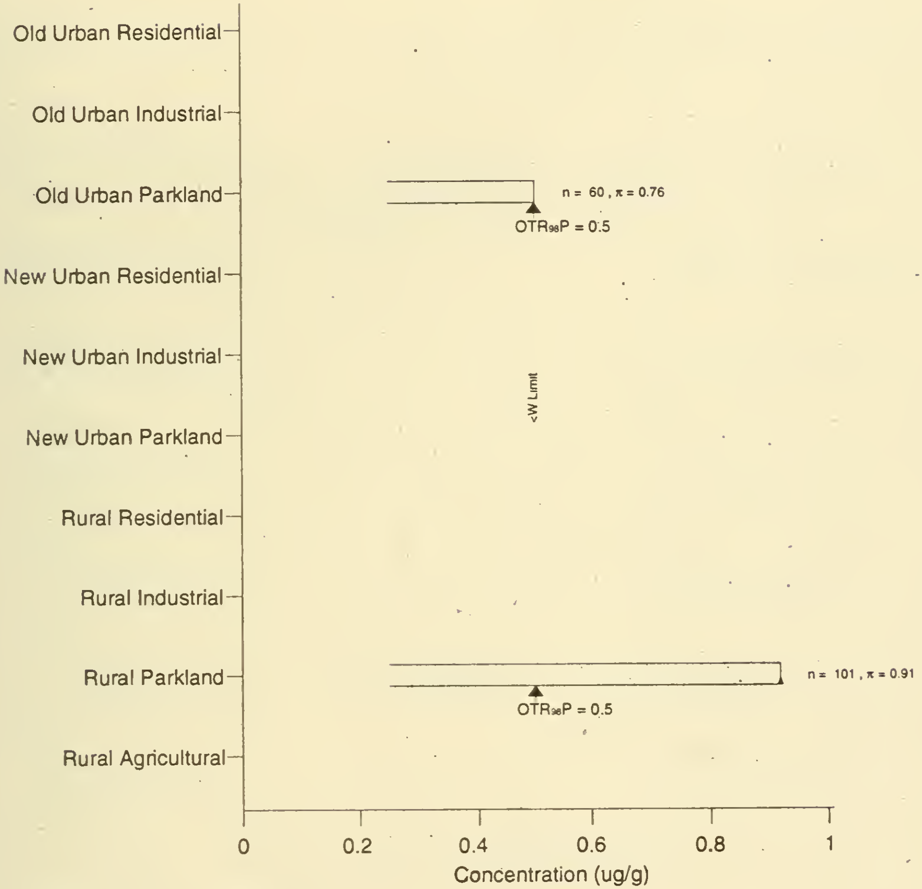


Figure 6.1.10

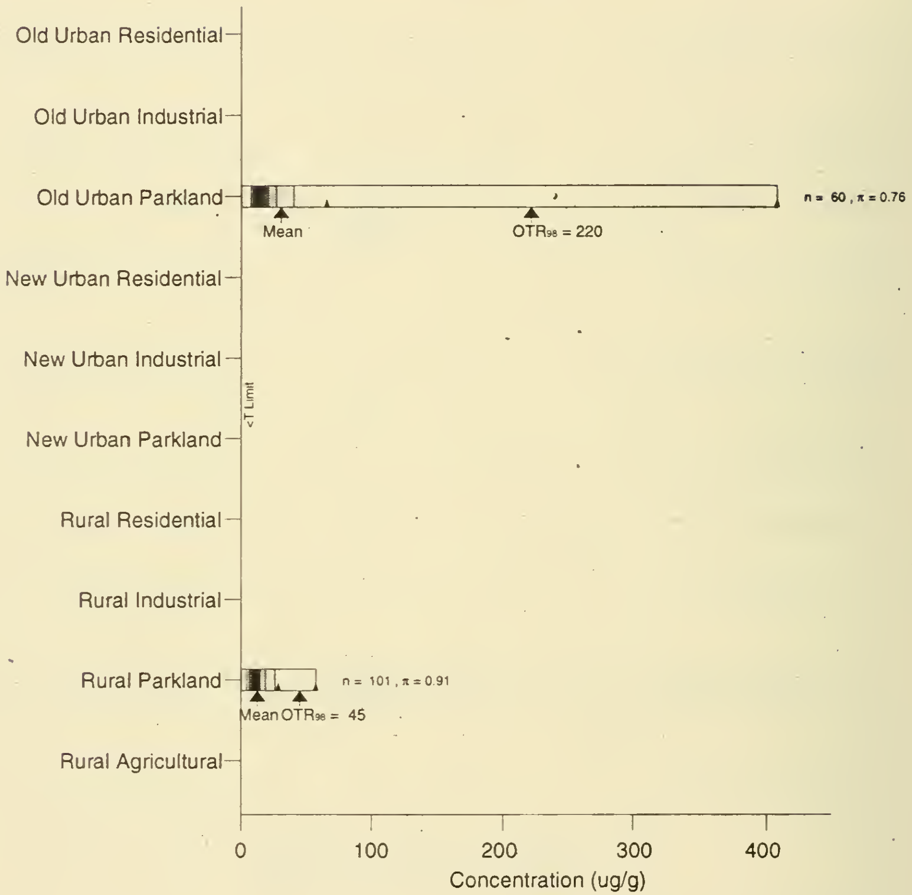
Ontario Typical Range

Chromium +6 in Class 1 Soils



OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.11



Ontario Typical Range

Aq. Ext. Chloride in Class 1 Soils

Figure 6.1.12

Ontario Typical Range

Cobalt in Class 1 Soils

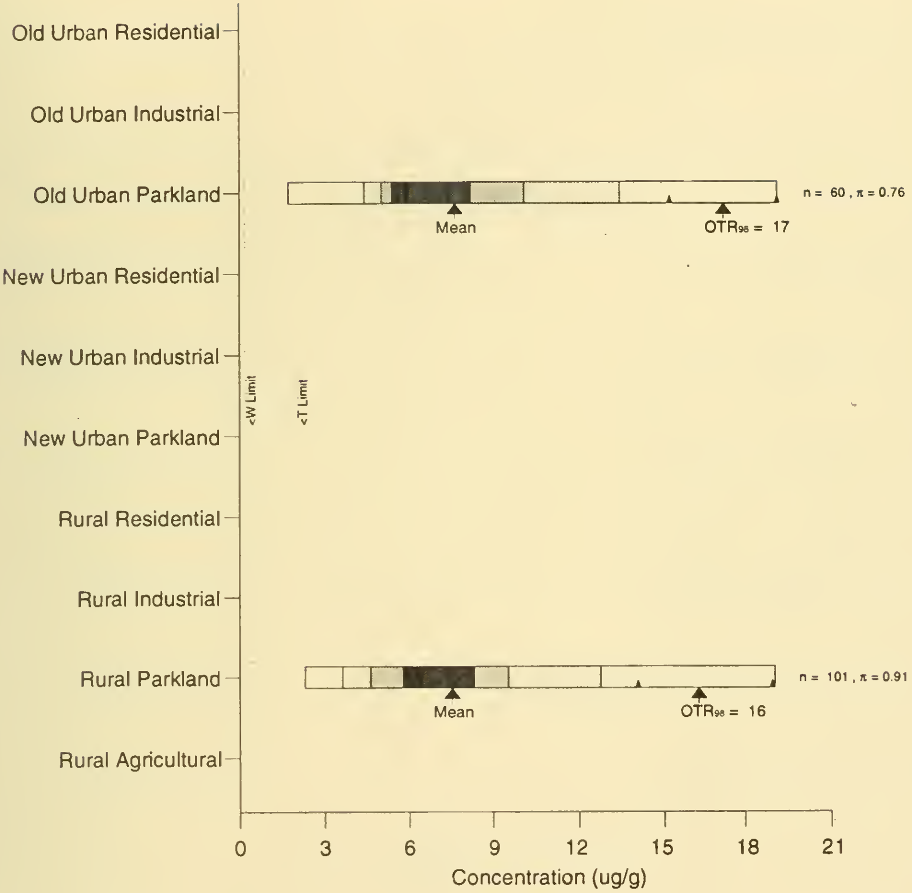


Figure 6.1.13

Ontario Typical Range

Copper in Class 1 Soils

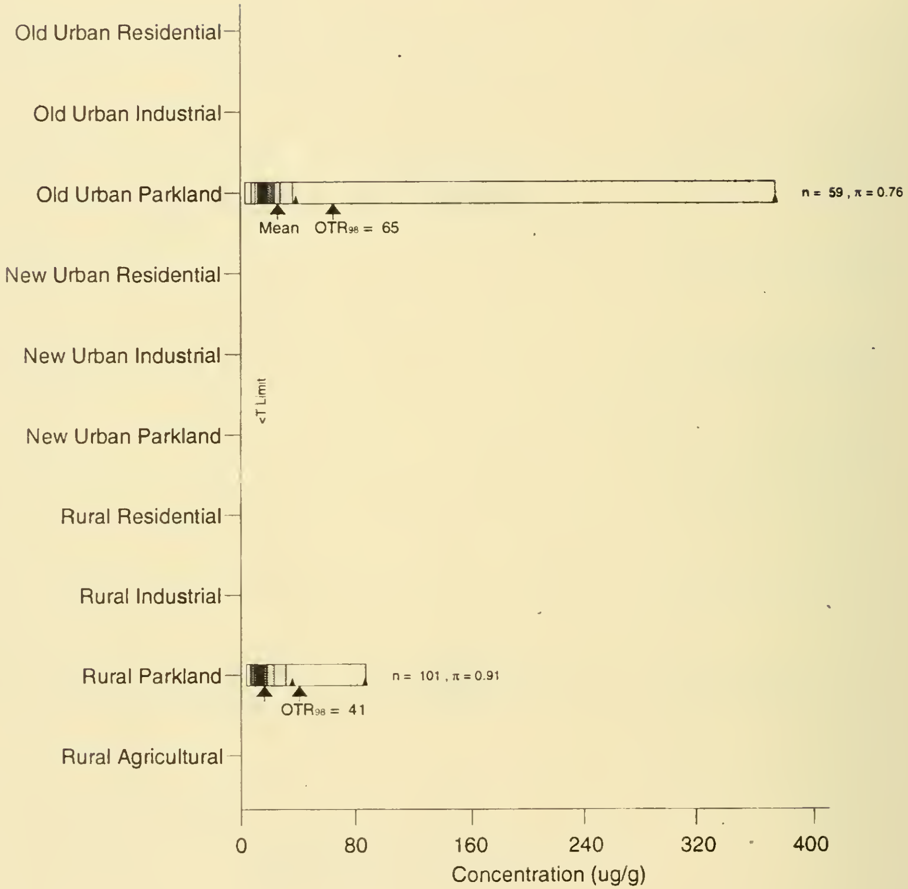
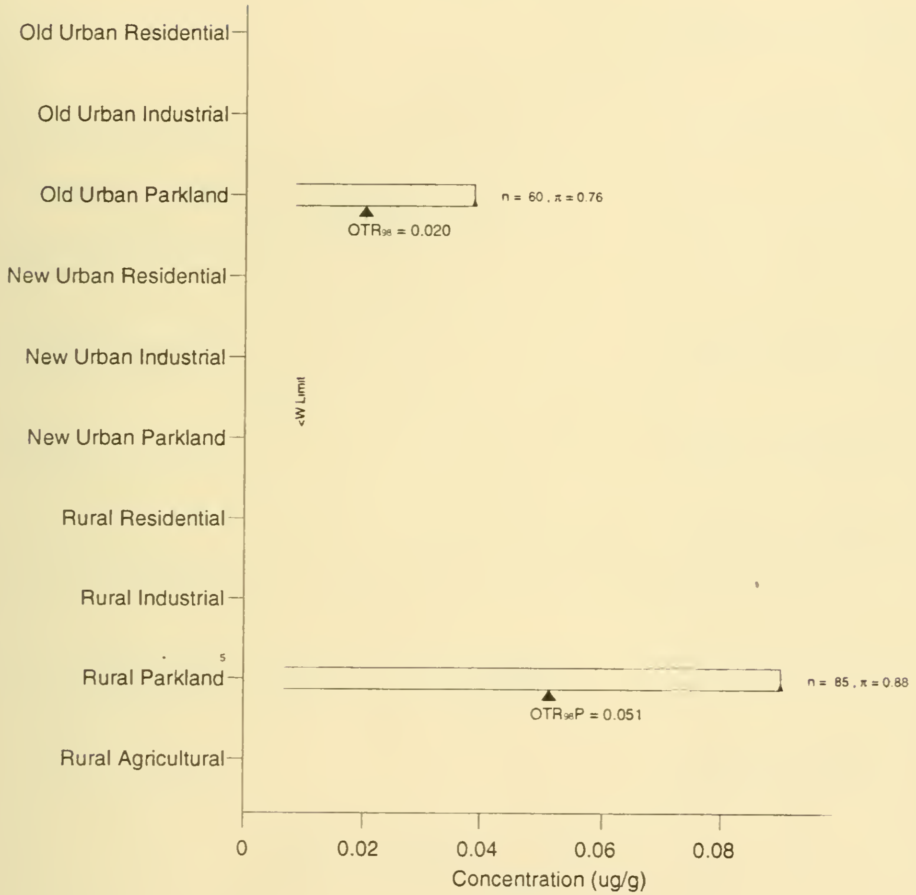


Figure 6.1.14

Ontario Typical Range

Cyanide (free) in Class 1 Soils



5. Does not include the Northeast Region

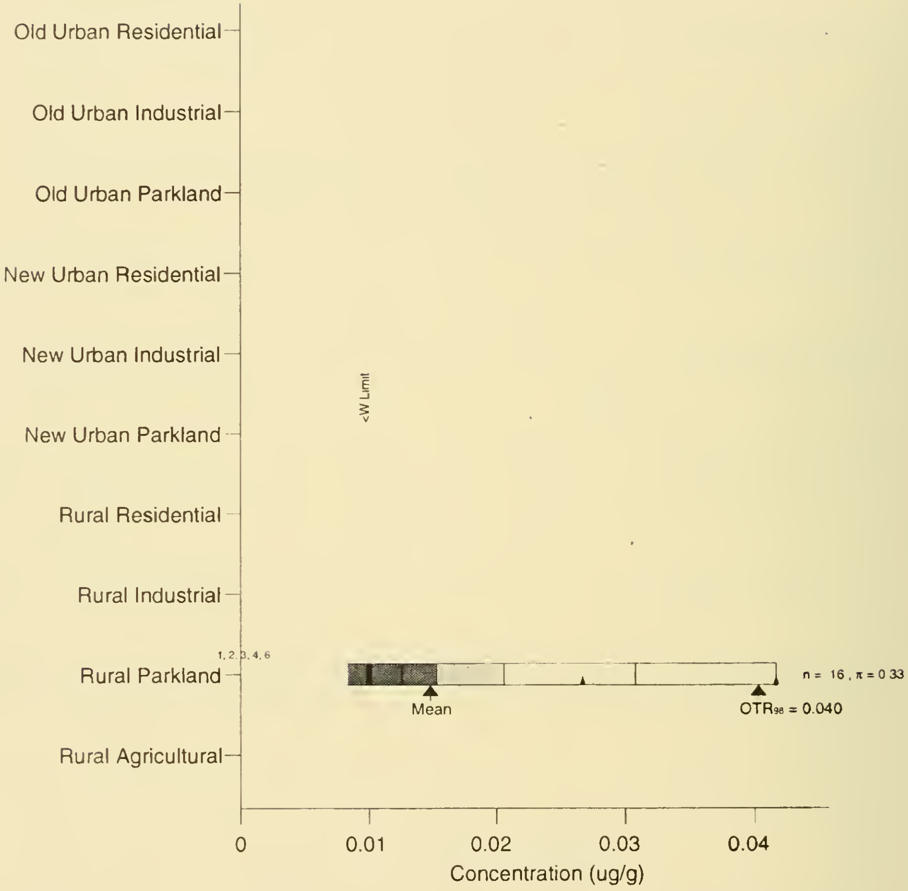
OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.15

Ontario Typical Range

Cyanide (free) in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
6. Does not include the Northwest Region

Figure 6.1.16

Ontario Typical Range

Fluoride in Class 1 Soils

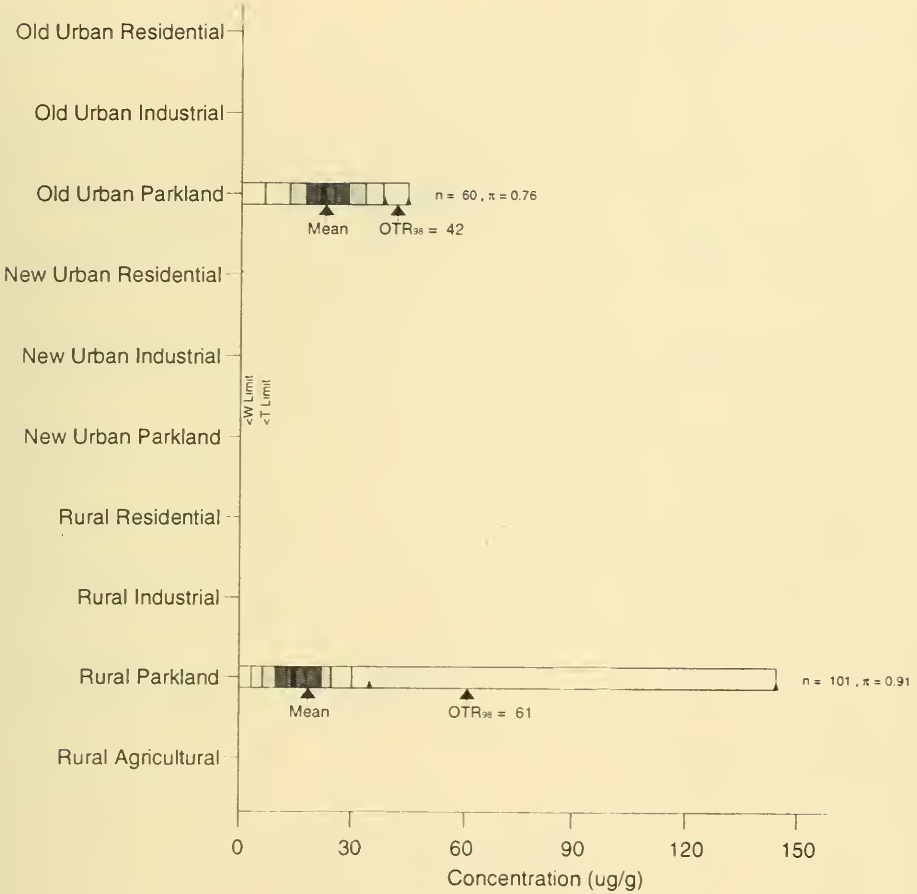


Figure 6.1.17

Ontario Typical Range

Iron in Class 1 Soils

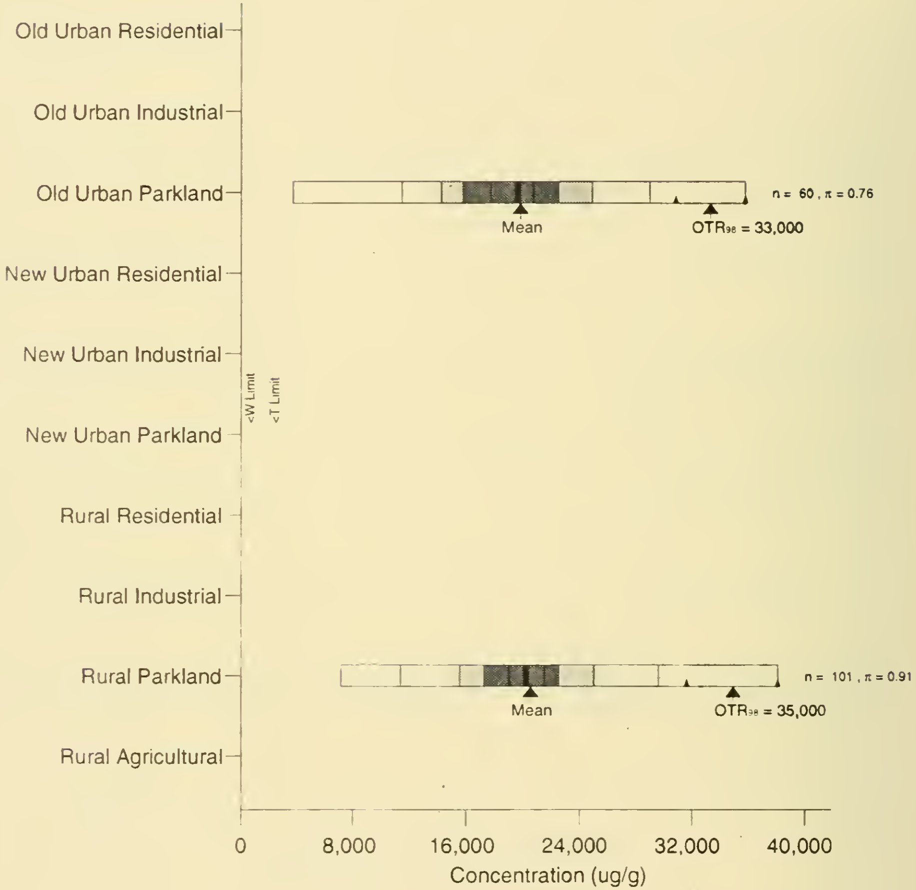


Figure 6.1.18

Ontario Typical Range

Lead in Class 1 Soils

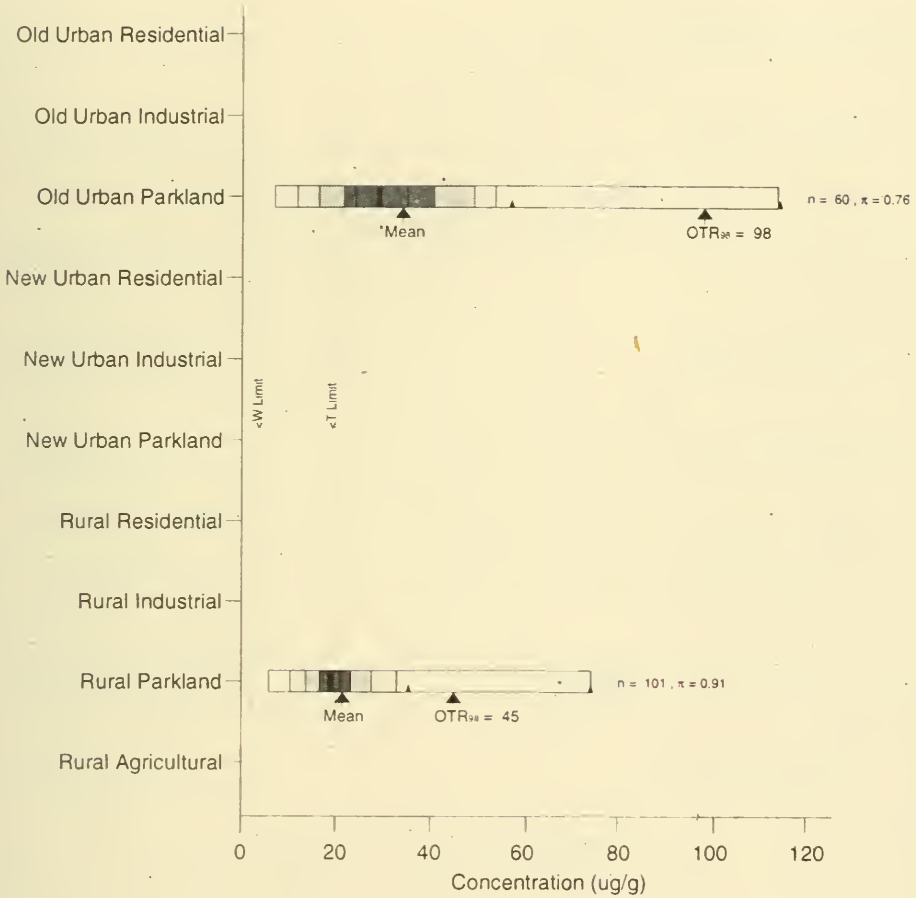


Figure 6.1.19

Ontario Typical Range

Magnesium in Class 1 Soils

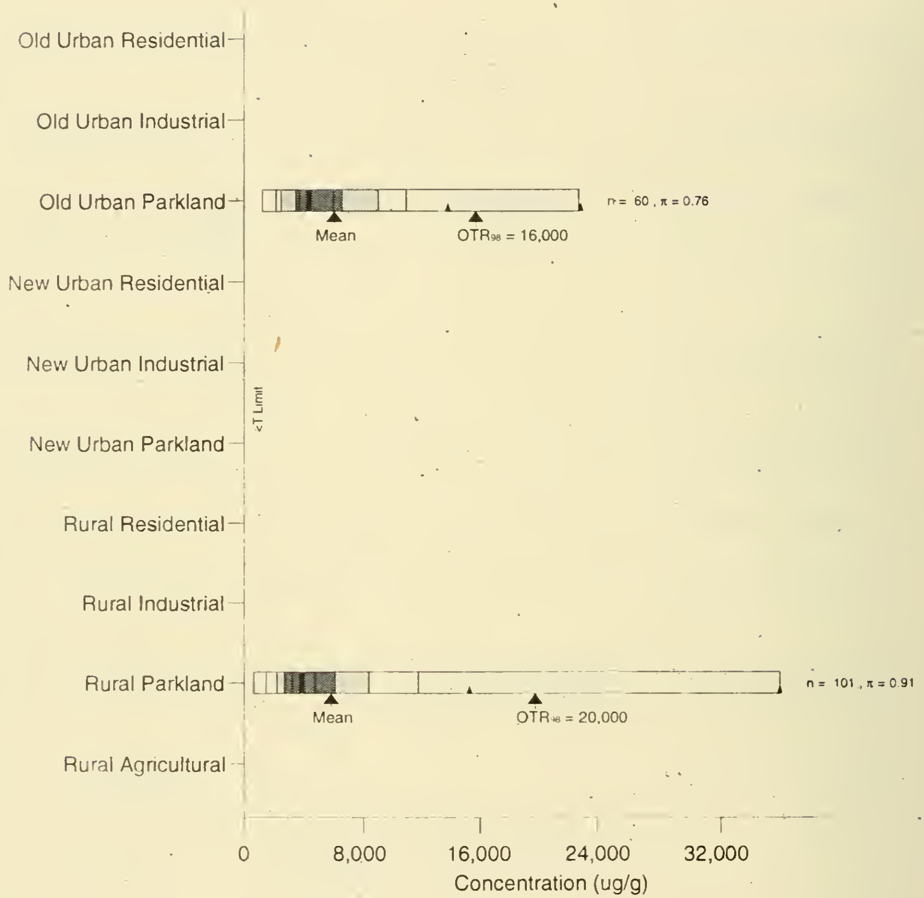
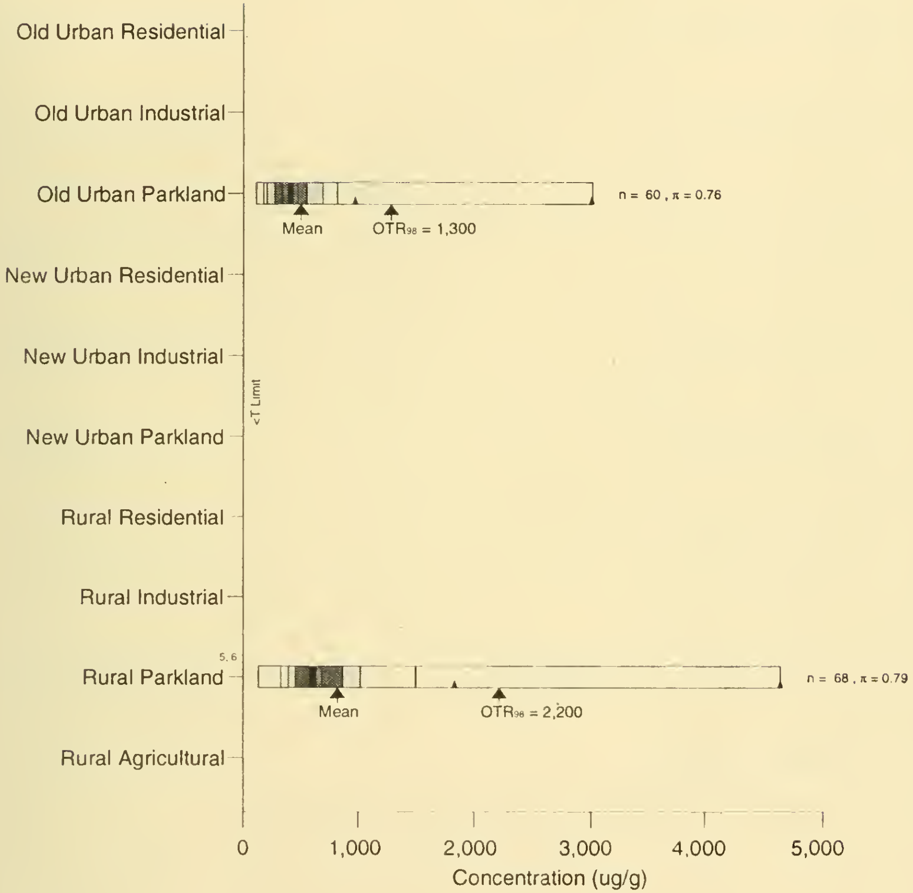


Figure 6.1.20

Ontario Typical Range

Manganese in Class 1 Soils



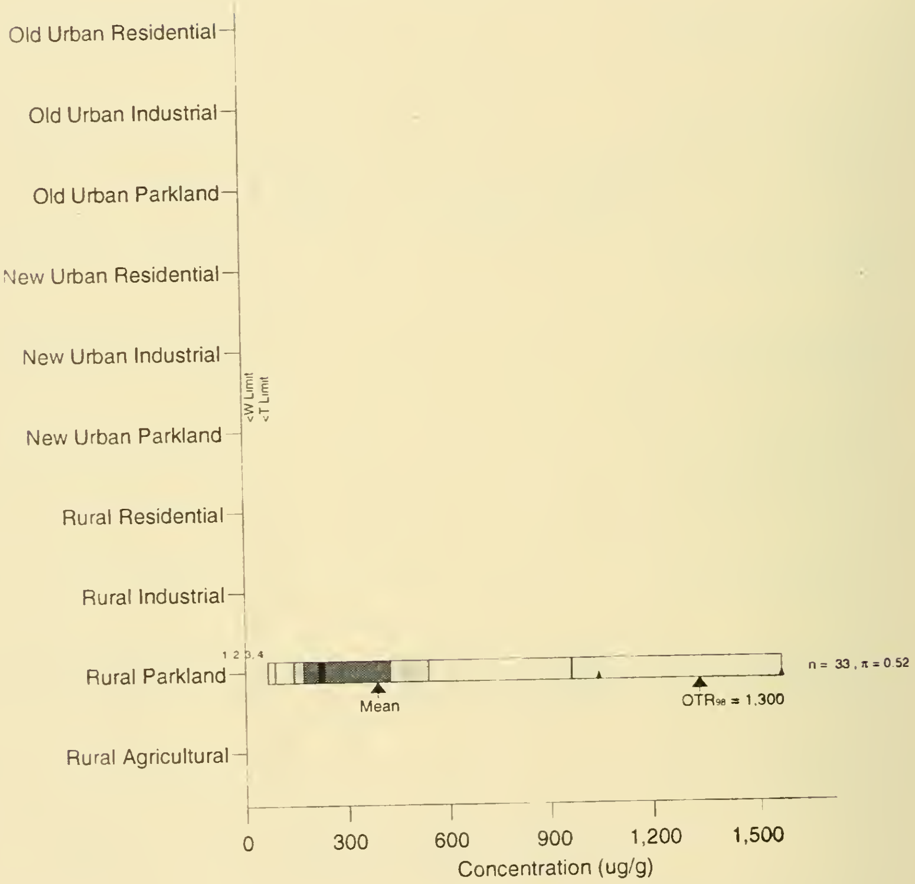
5. Does not include the Northeast Region
6 Does not include the Northwest Region

Figure 6.1.21

Ontario Typical Range

Manganese in Class 1 Soils

(For Regions Rejected by KS Test)



1 Does not include the Southwest Region
2 Does not include the WestCentral Region
3 Does not include the Central Region
4 Does not include the Southeast Region

Figure 6.1.22

Ontario Typical Range

Mercury in Class 1 Soils

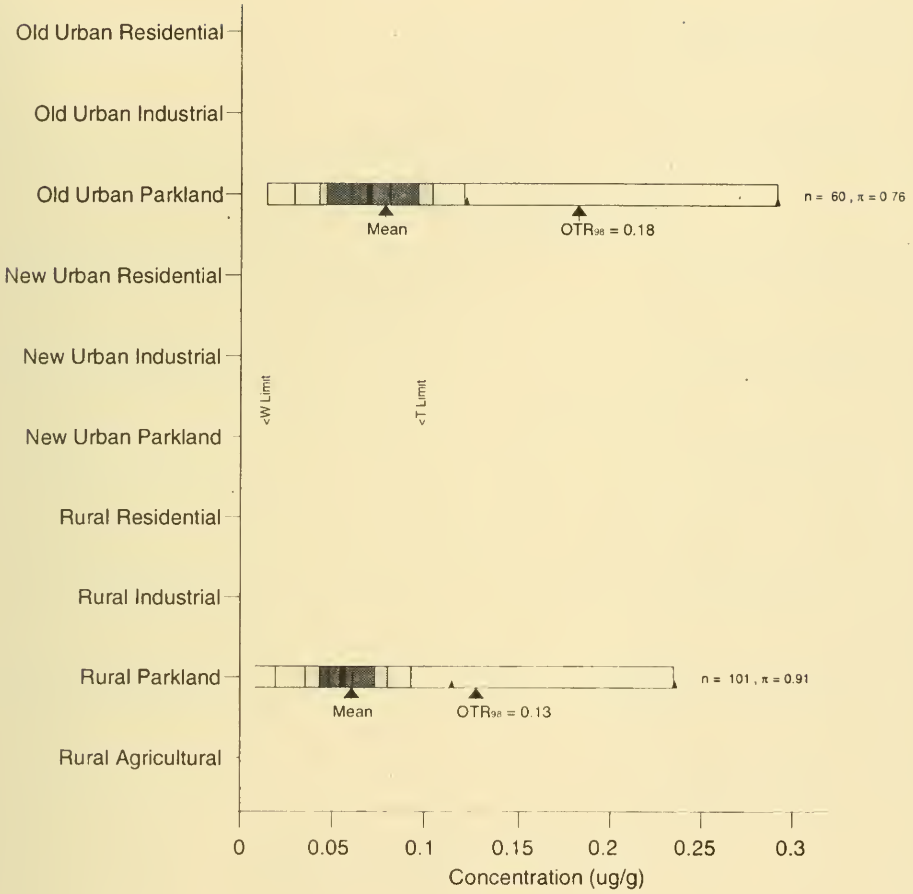


Figure 6.1.23

Ontario Typical Range

Molybdenum in Class 1 Soils

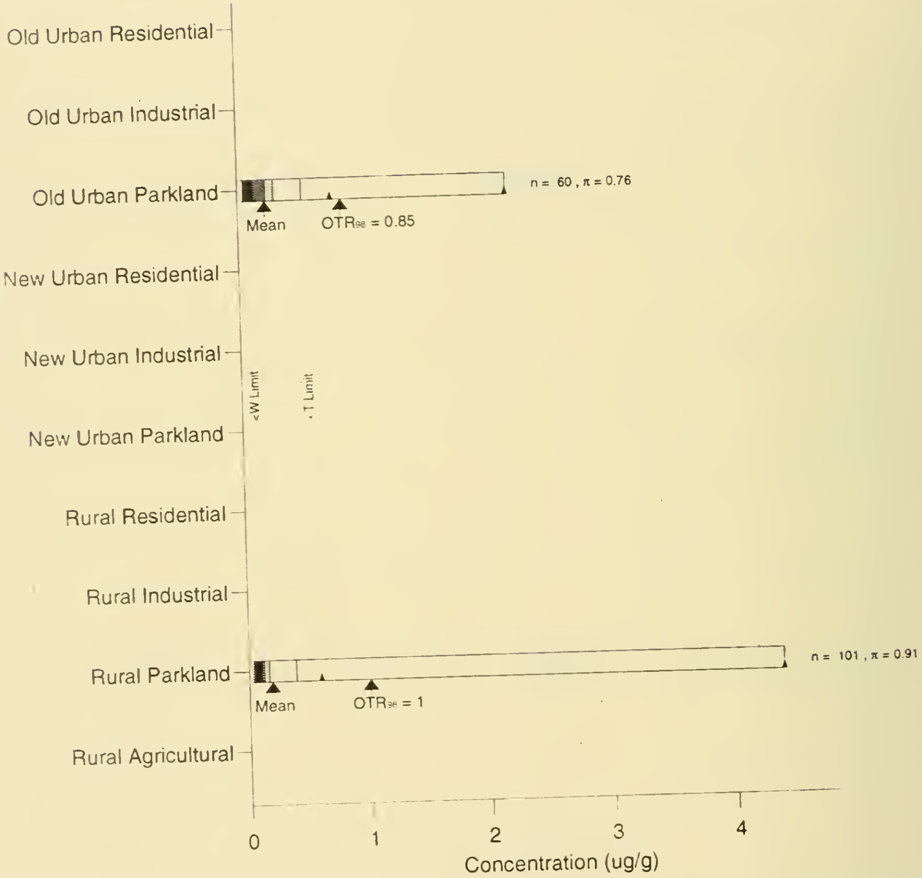


Figure 6.1.24

Ontario Typical Range

Nickel in Class 1 Soils

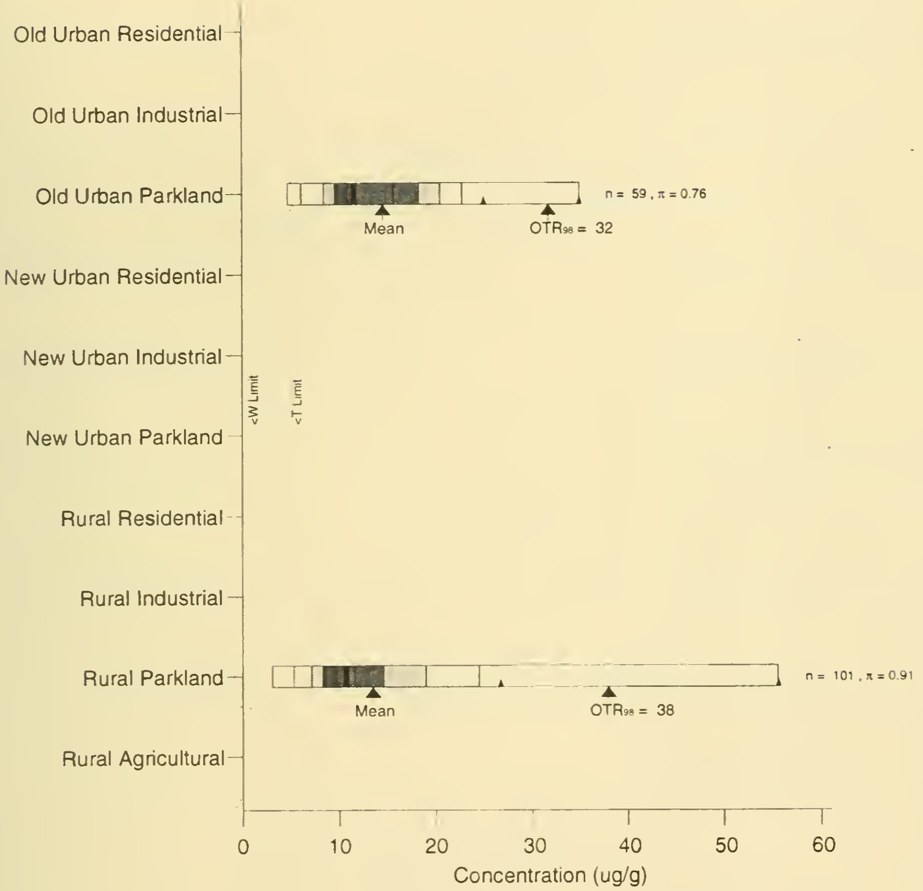
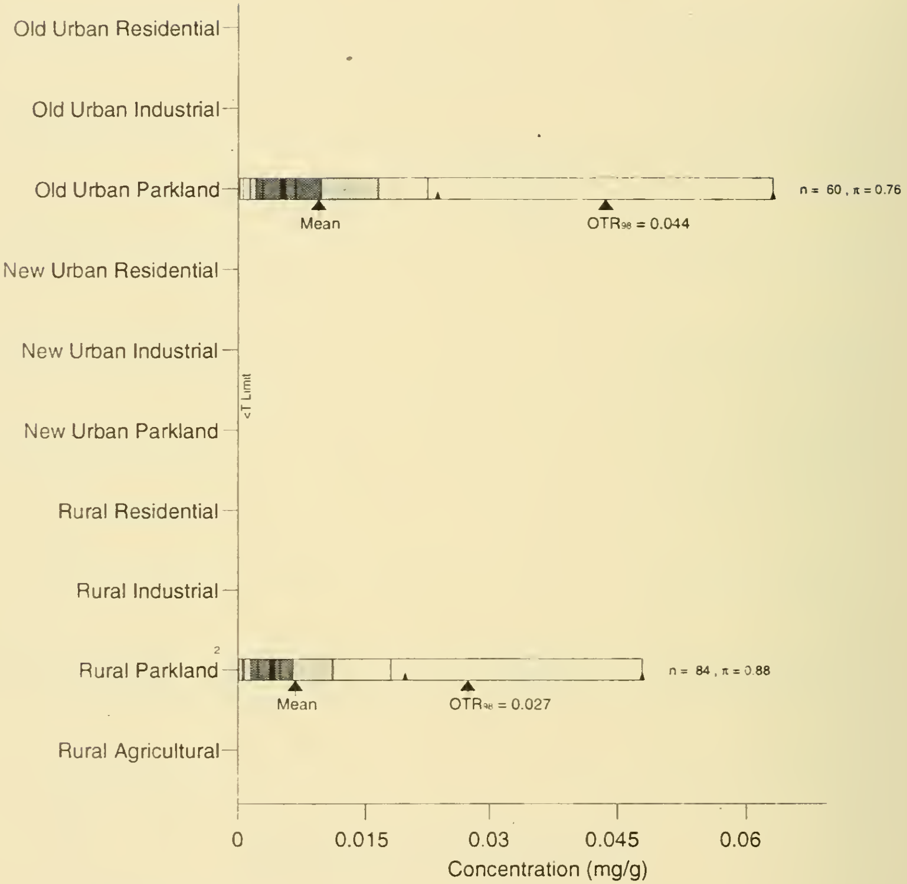


Figure 6.1.25

Ontario Typical Range

Nitrate+Nitrite in Class 1 Soils



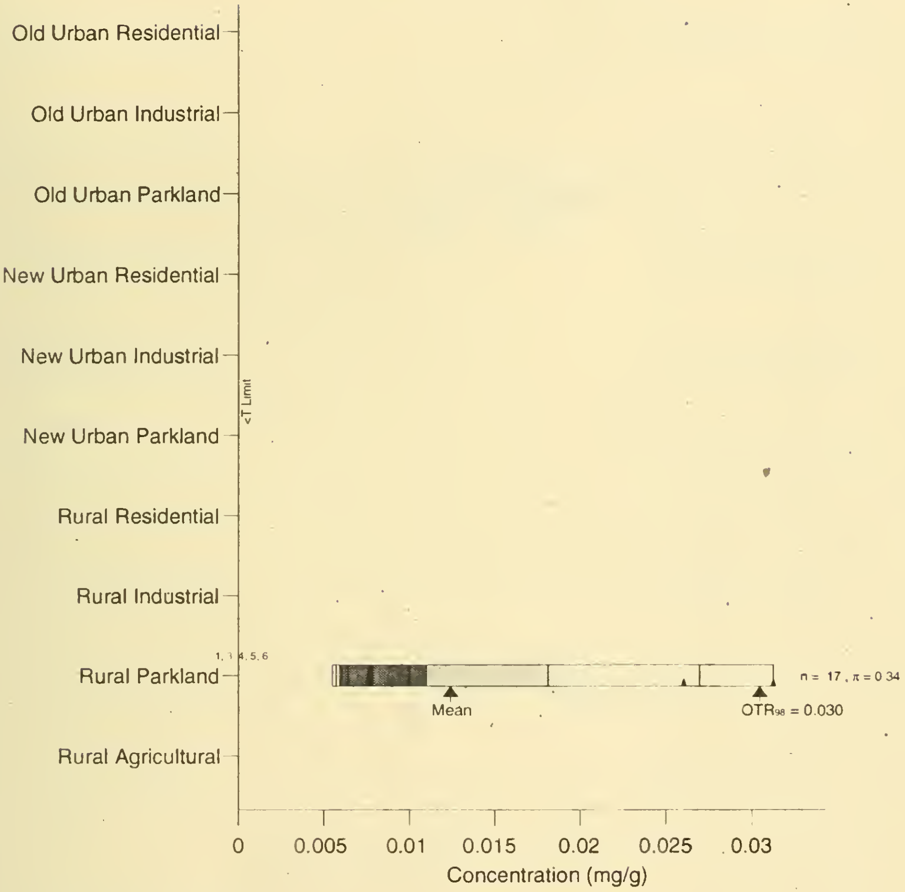
2 Does not include the WestCentral Region

Figure 6.1.26

Ontario Typical Range

Nitrate+Nitrite in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region
6. Does not include the Northwest Region

Figure 6.1.27

Ontario Typical Range

Nitrogen,Total Kjeldahl in Class 1 Soils

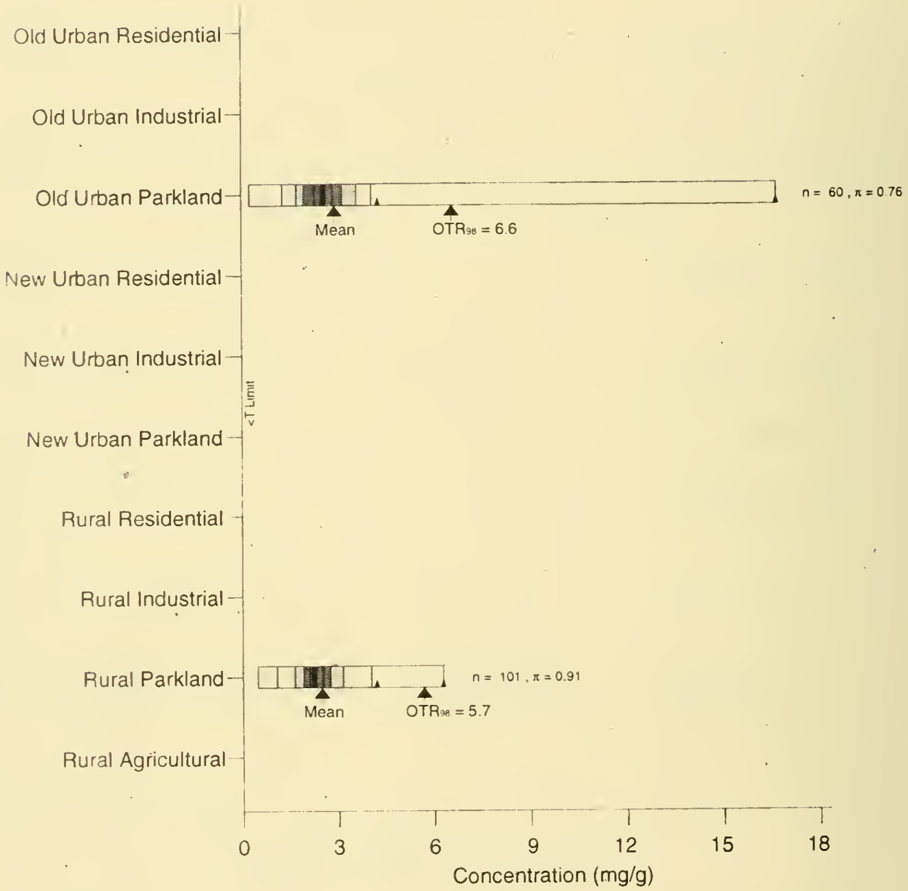
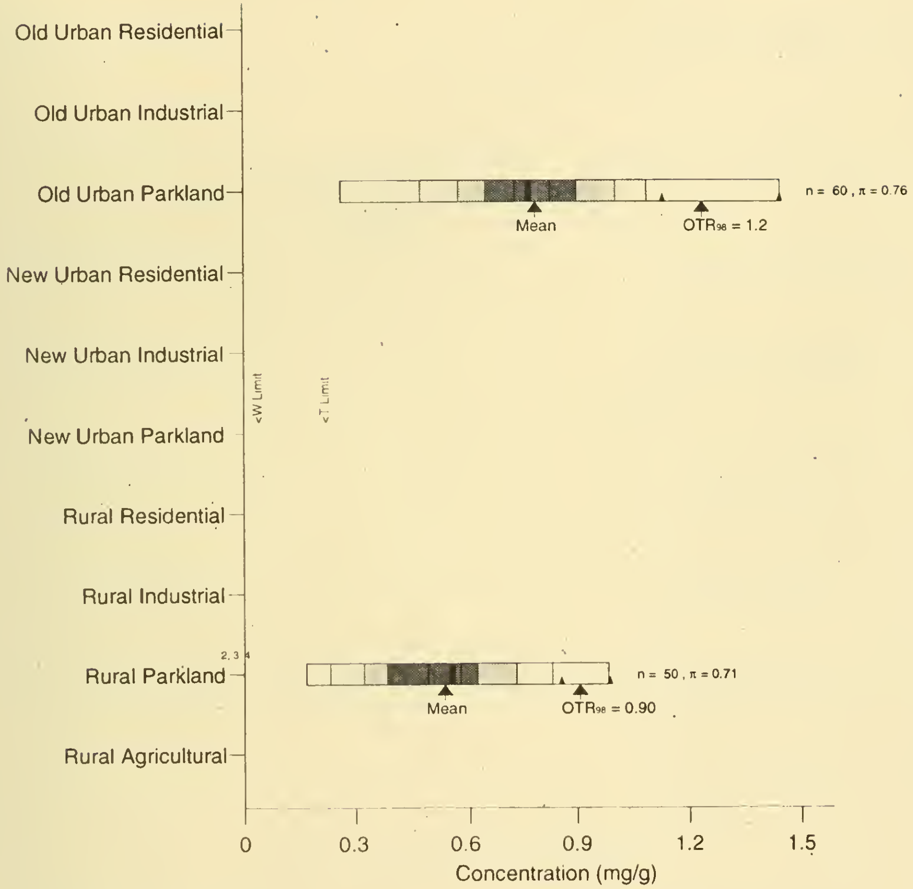


Figure 6.1.28

Ontario Typical Range

Phosphorus in Class 1 Soils



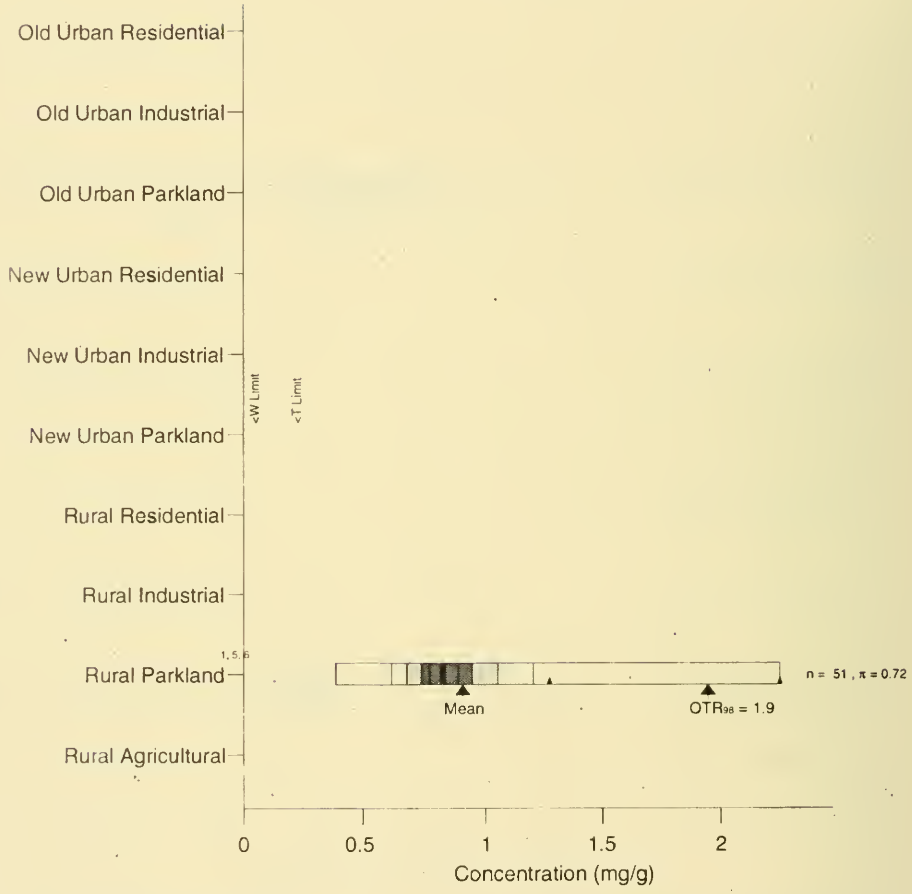
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region

Figure 6.1.29

Ontario Typical Range

Phosphorus in Class 1 Soils

(For Regions Rejected by KS Test)



1 Does not include the Southwest Region
5 Does not include the Northeast Region
6 Does not include the Northwest Region

Figure 6.1.30

Ontario Typical Range

Potassium in Class 1 Soils

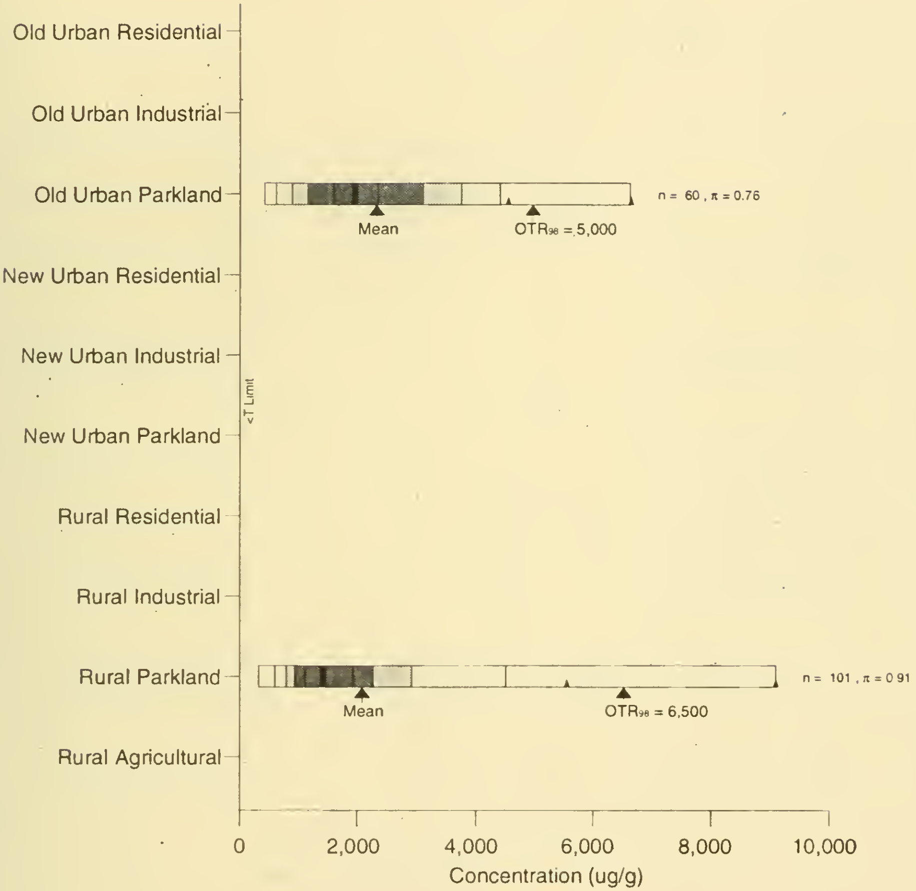


Figure 6.1.31

Ontario Typical Range

Selenium in Class 1 Soils

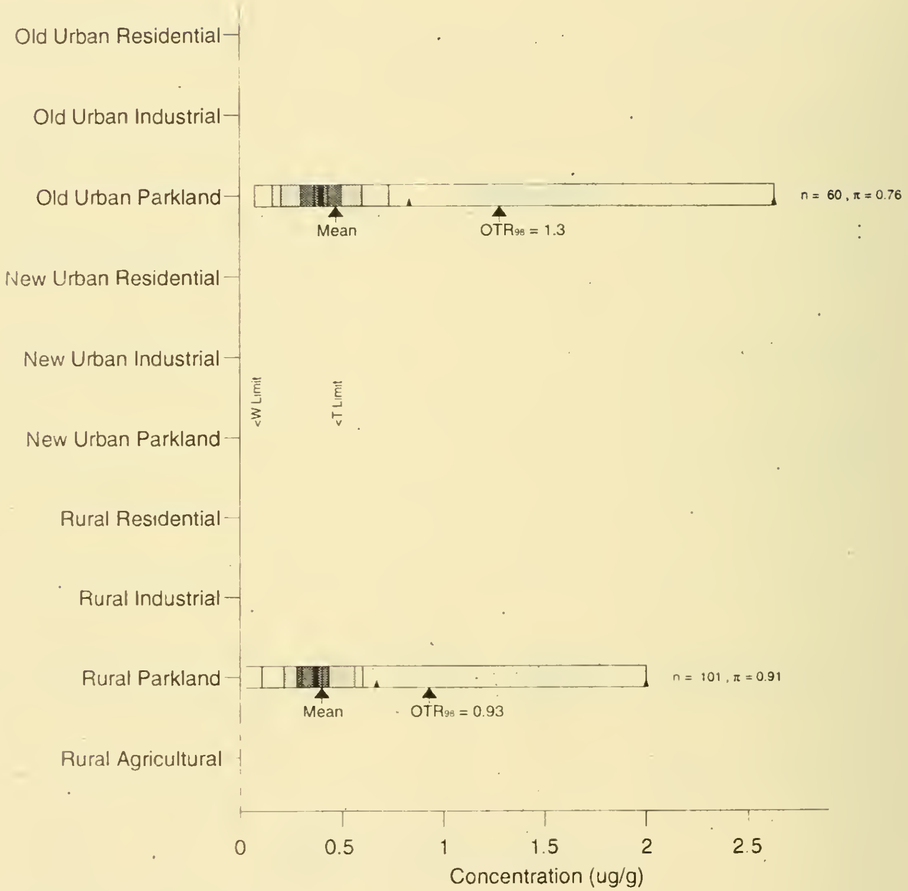
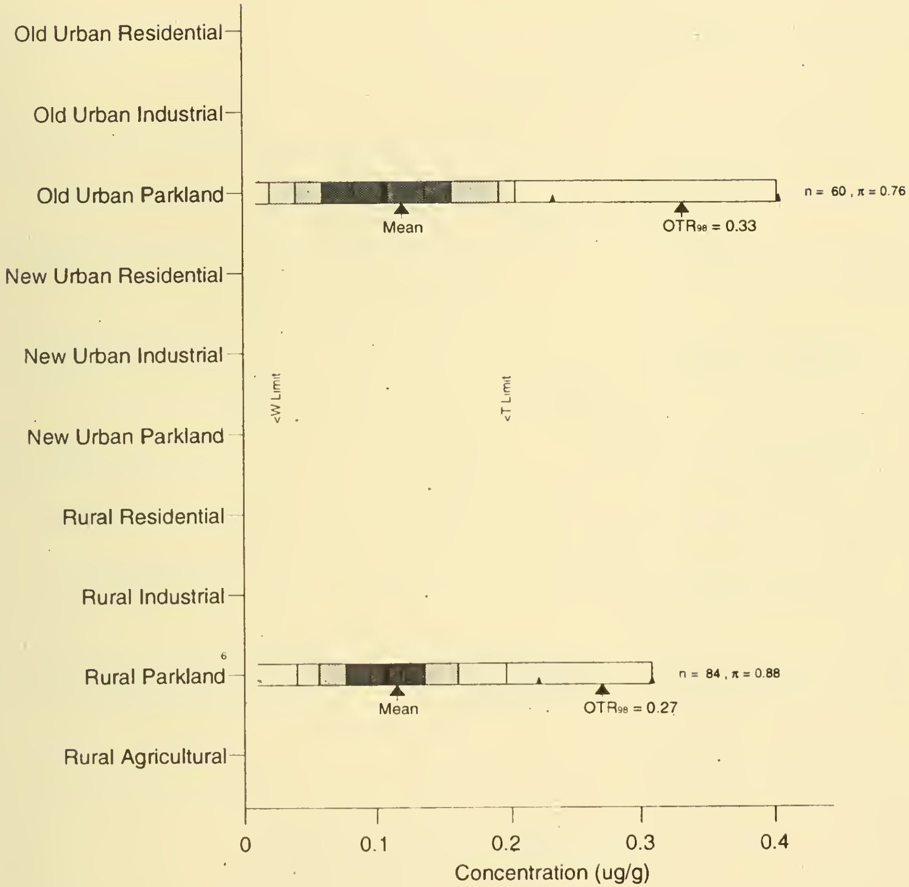


Figure 6.1.32

Ontario Typical Range

Silver in Class 1 Soils



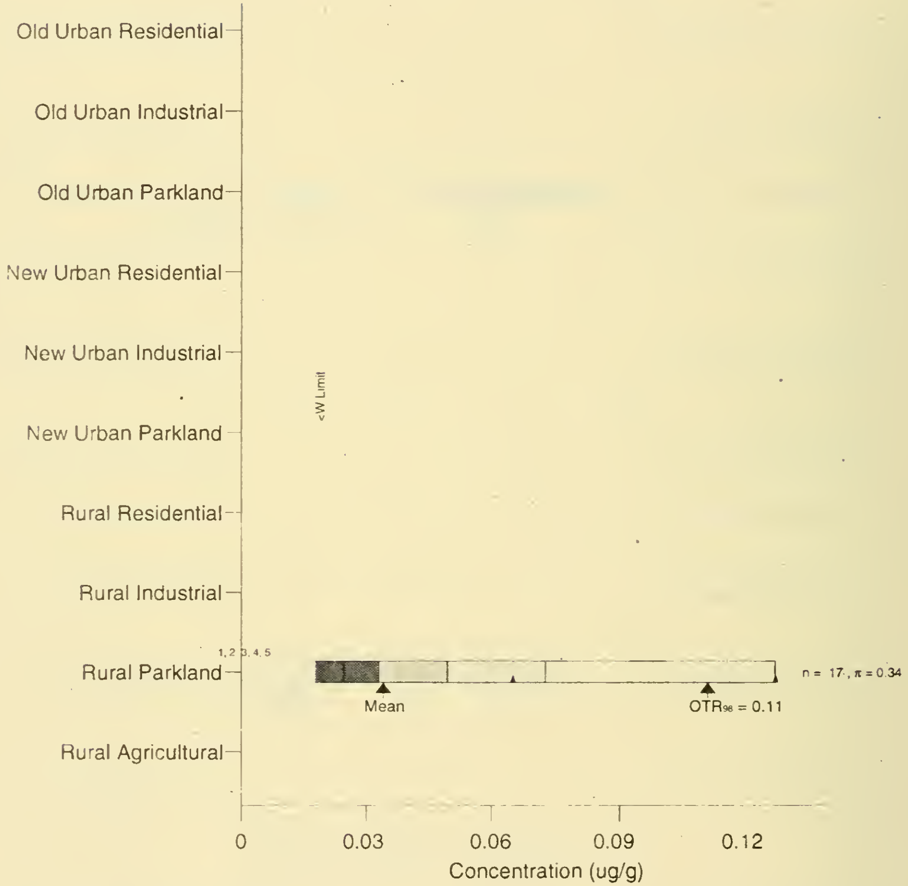
6. Does not include the Northwest Region

Figure 6.1.33

Ontario Typical Range

Silver in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.34

Ontario Typical Range

Sodium in Class 1 Soils

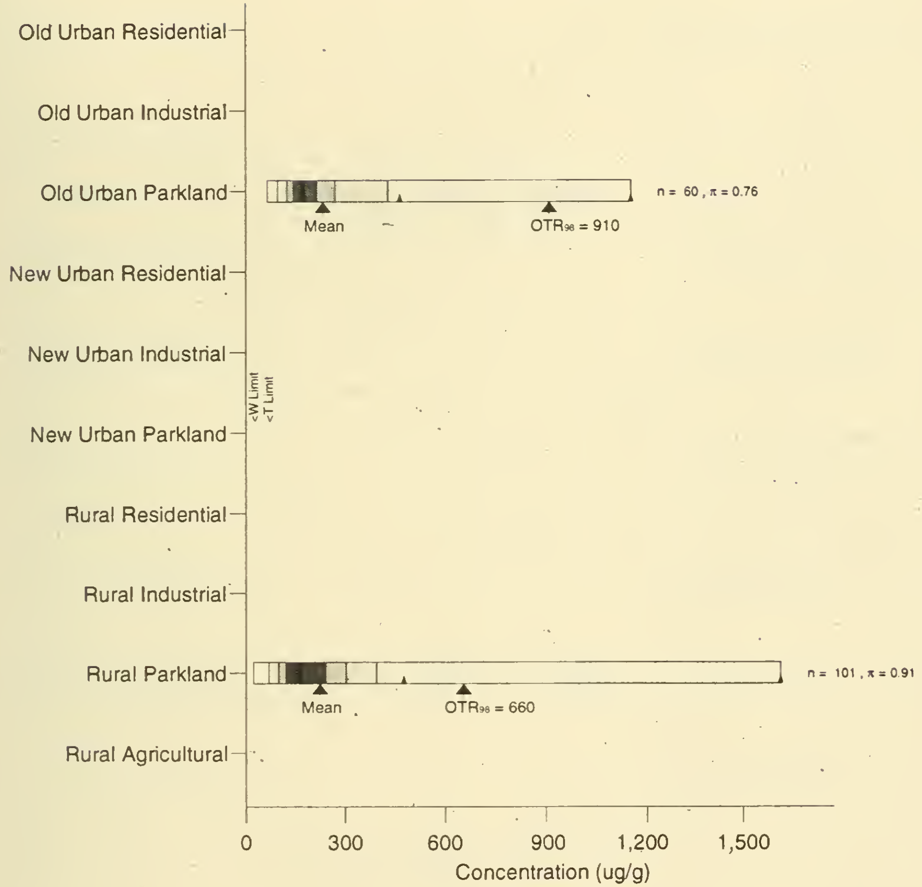


Figure 6.1.35

Ontario Typical Range

Strontium in Class 1 Soils

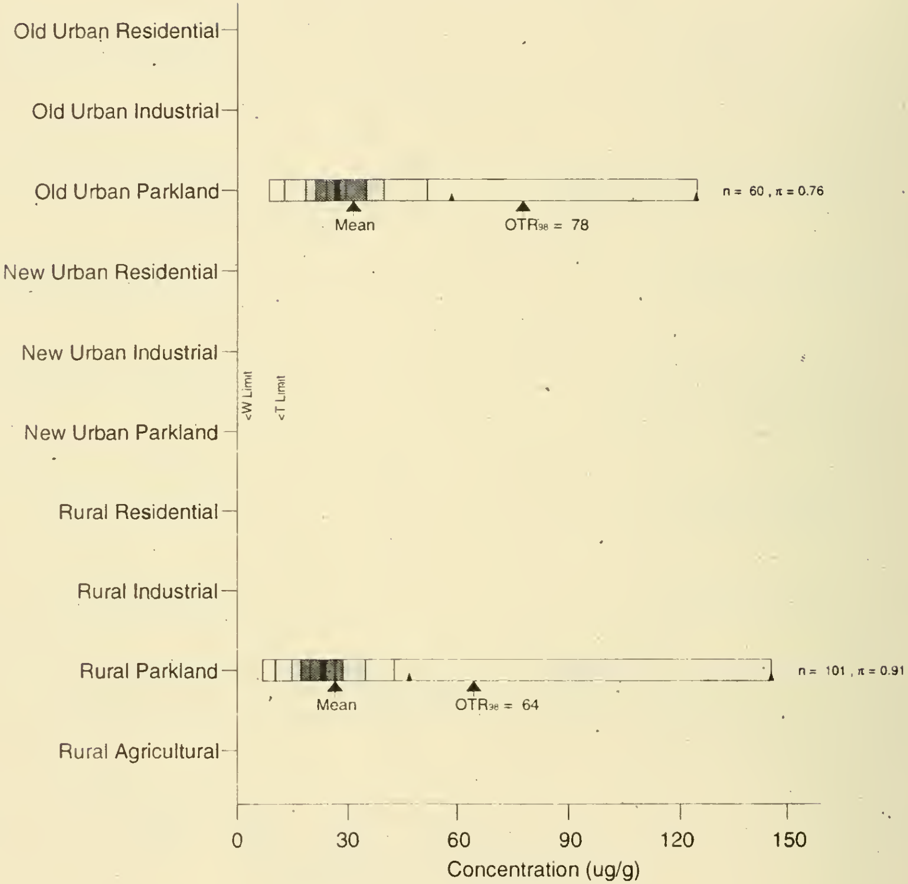


Figure 6.1.36

Ontario Typical Range

Sulphur in Class 1 Soils

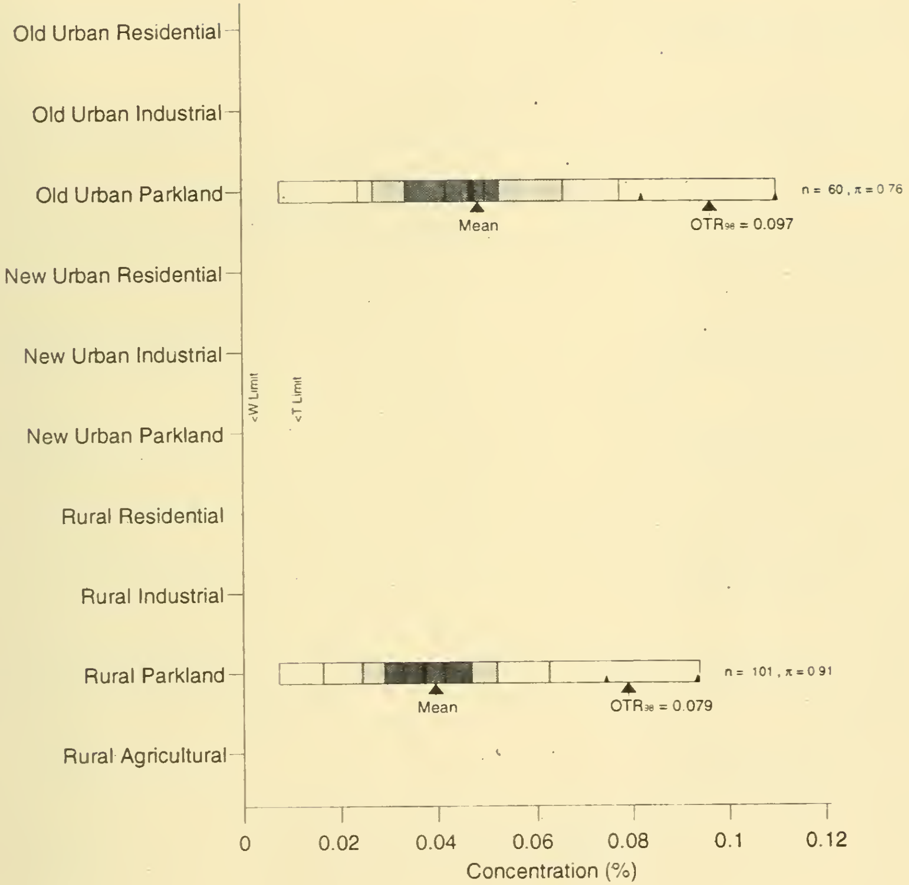


Figure 6.1.37

Ontario Typical Range

Thallium in Class 1 Soils

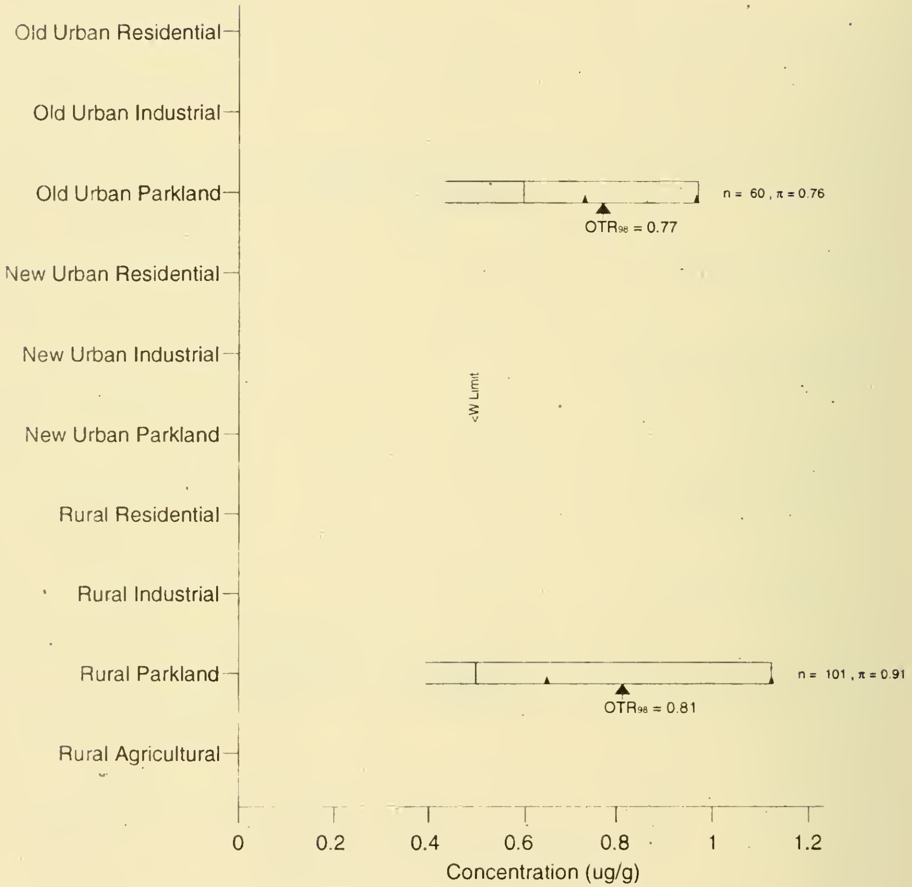


Figure 6.1.38

Ontario Typical Range

Titanium in Class 1 Soils

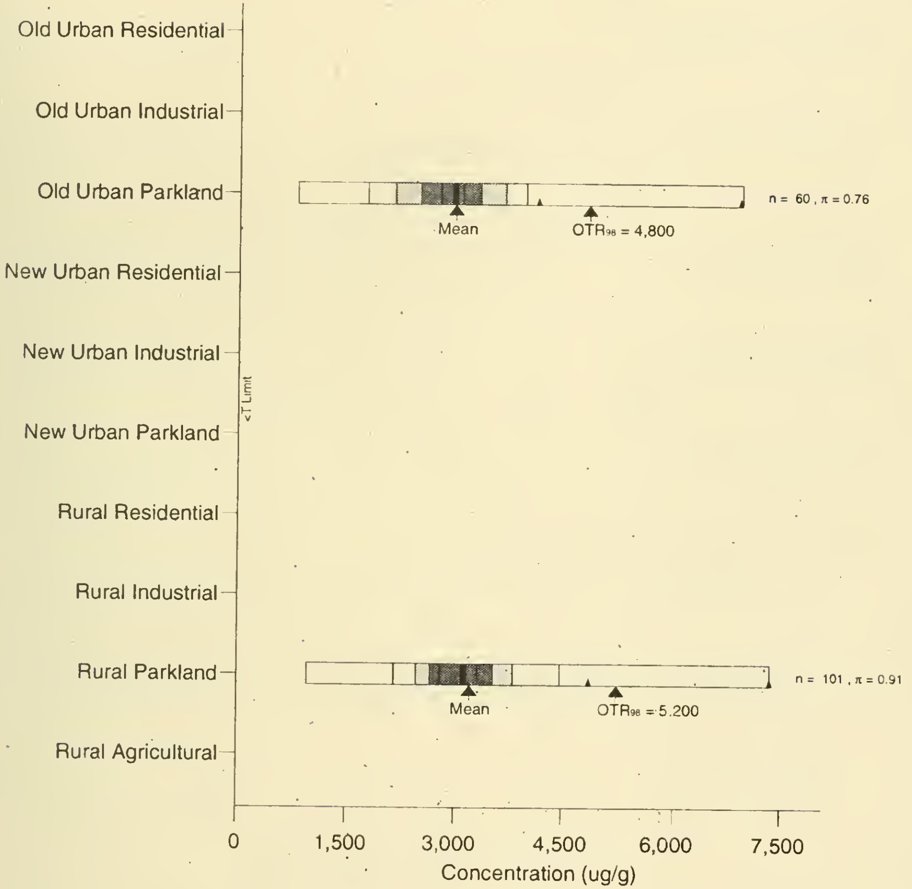
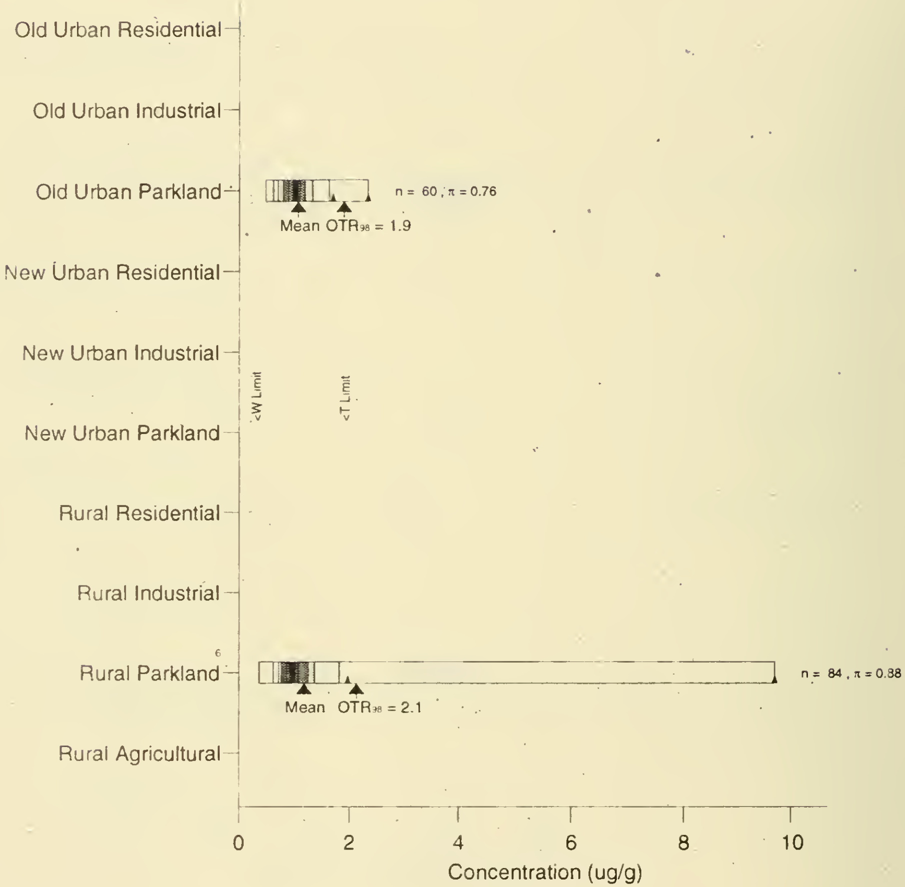


Figure 6.1.39

Ontario Typical Range

Uranium in Class 1 Soils



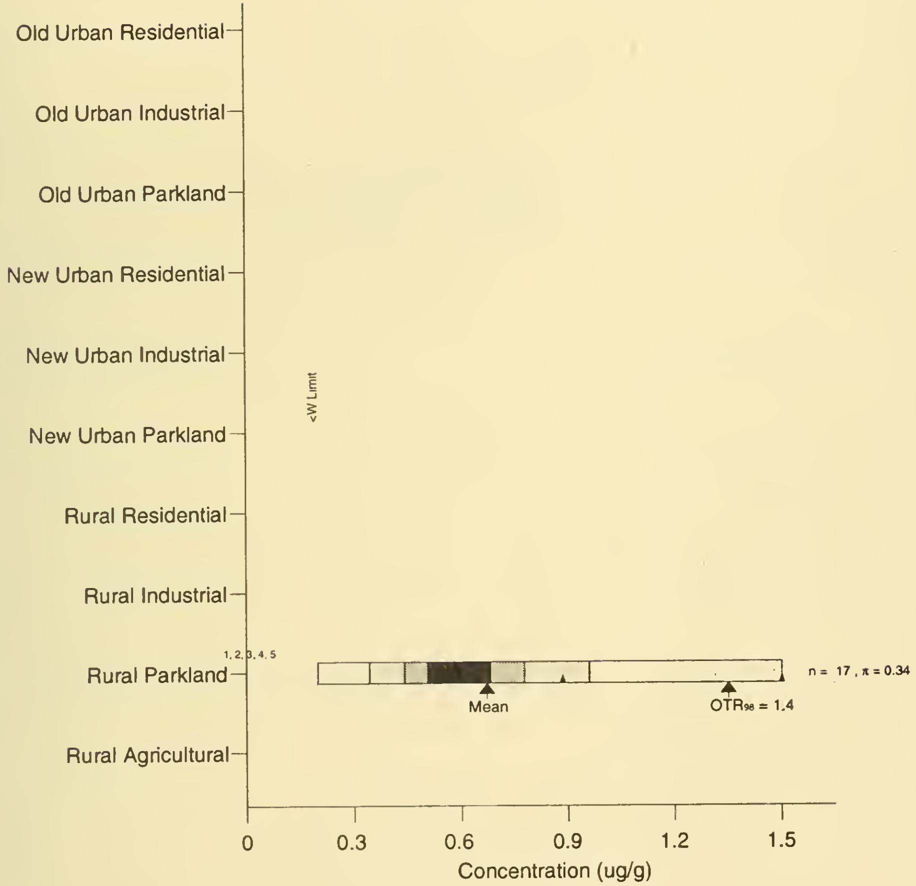
6 Does not include the Northwest Region

Figure 6.1.40

Ontario Typical Range

Uranium in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.41

Ontario Typical Range

Vanadium in Class 1 Soils

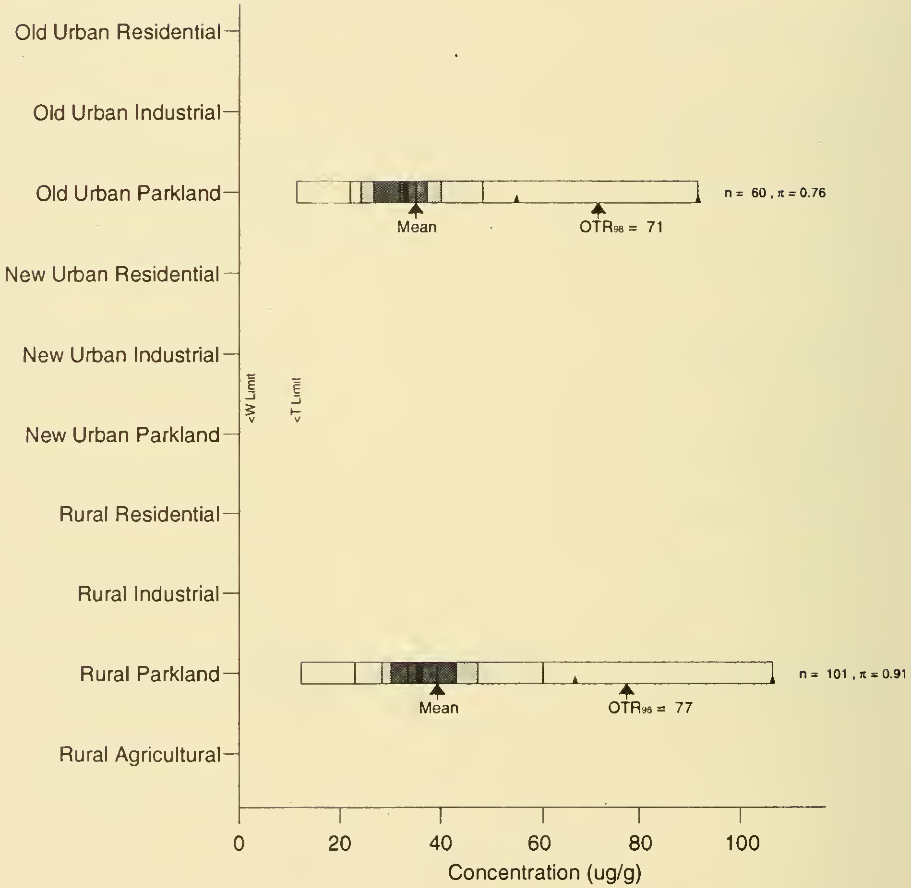


Figure 6.1.42

Ontario Typical Range

Zinc in Class 1 Soils

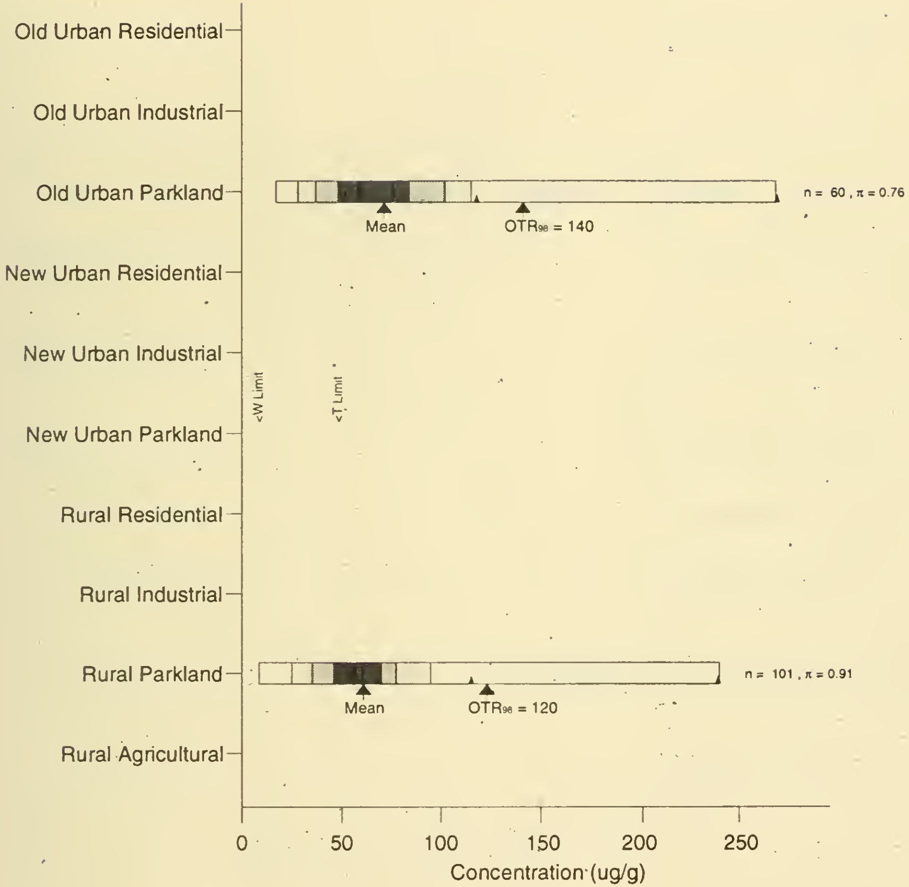


Figure 6.1.43

Ontario Typical Range

Conductivity 25C in Class 1 Soils

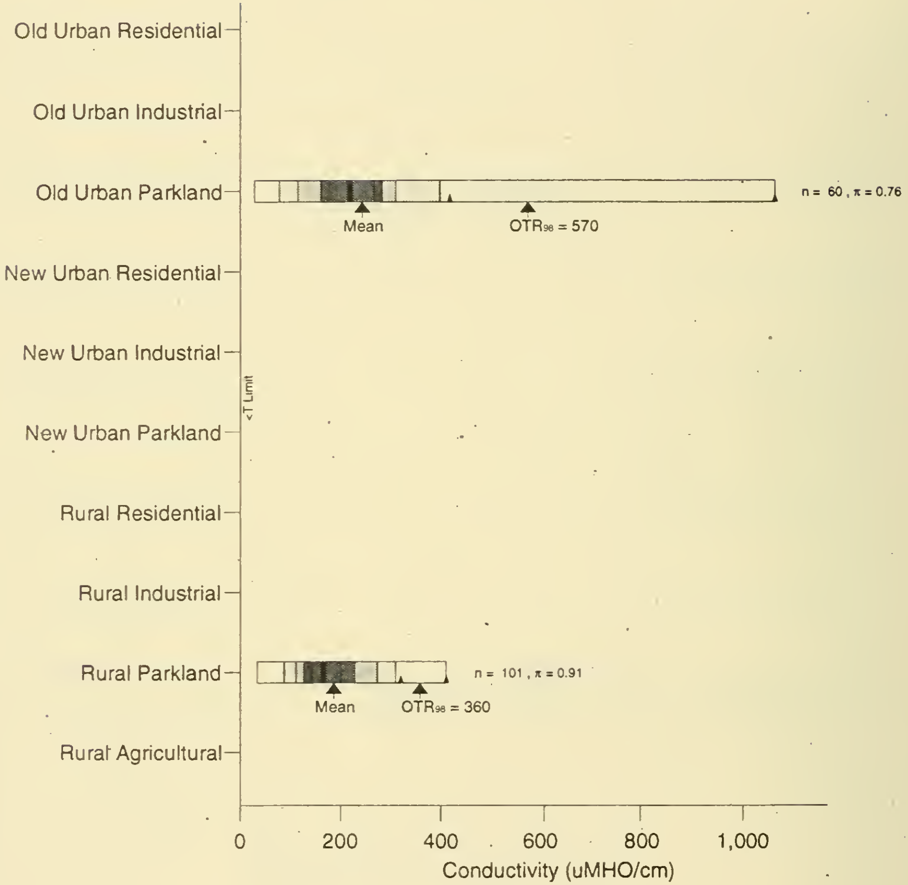


Figure 6.1.44

Ontario Typical Range

pH in Class 1 Soils

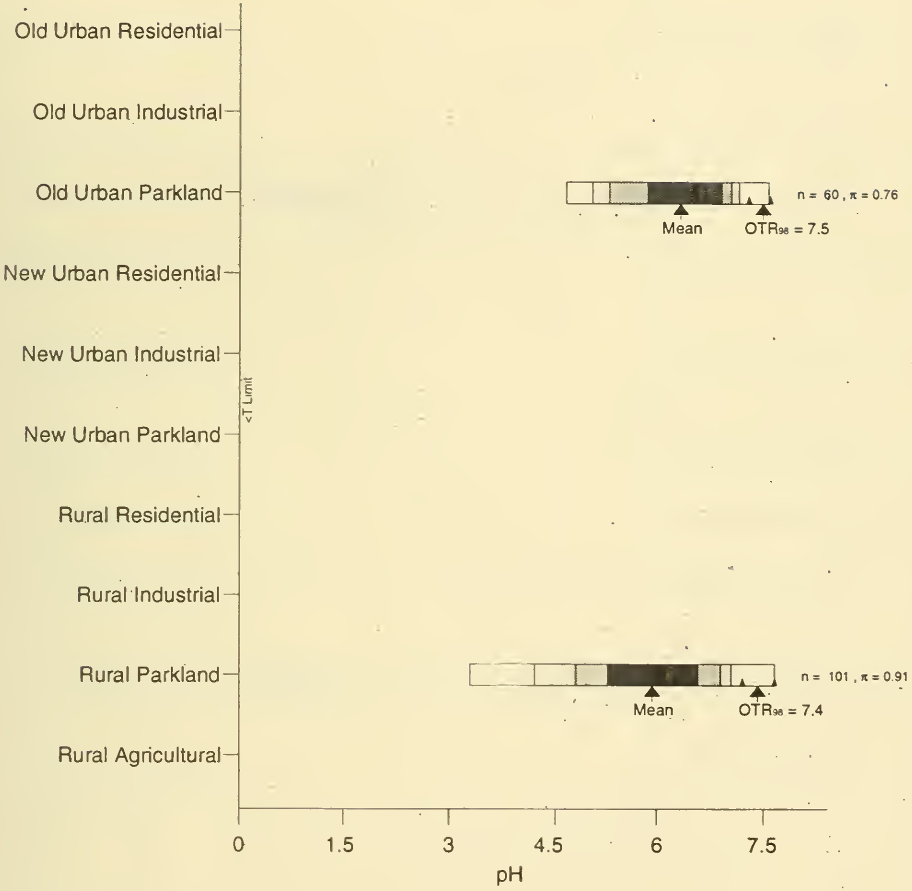


Figure 6.1.45

Ontario Typical Range

Sodium Absorption Ratio in Class 1 Soils

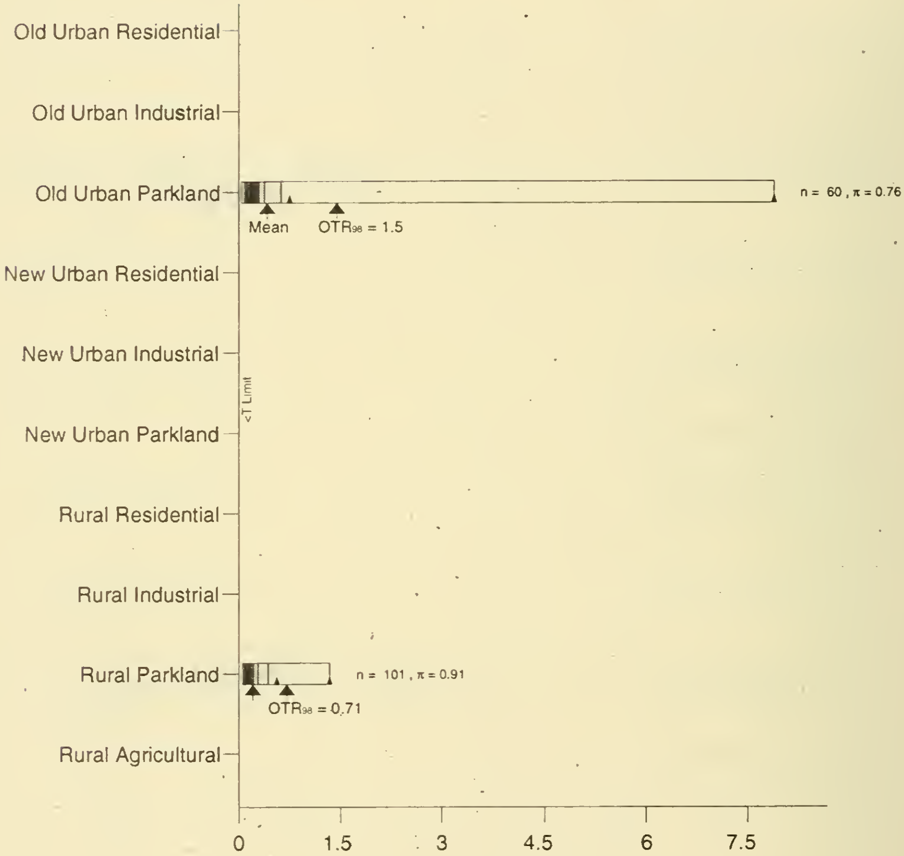
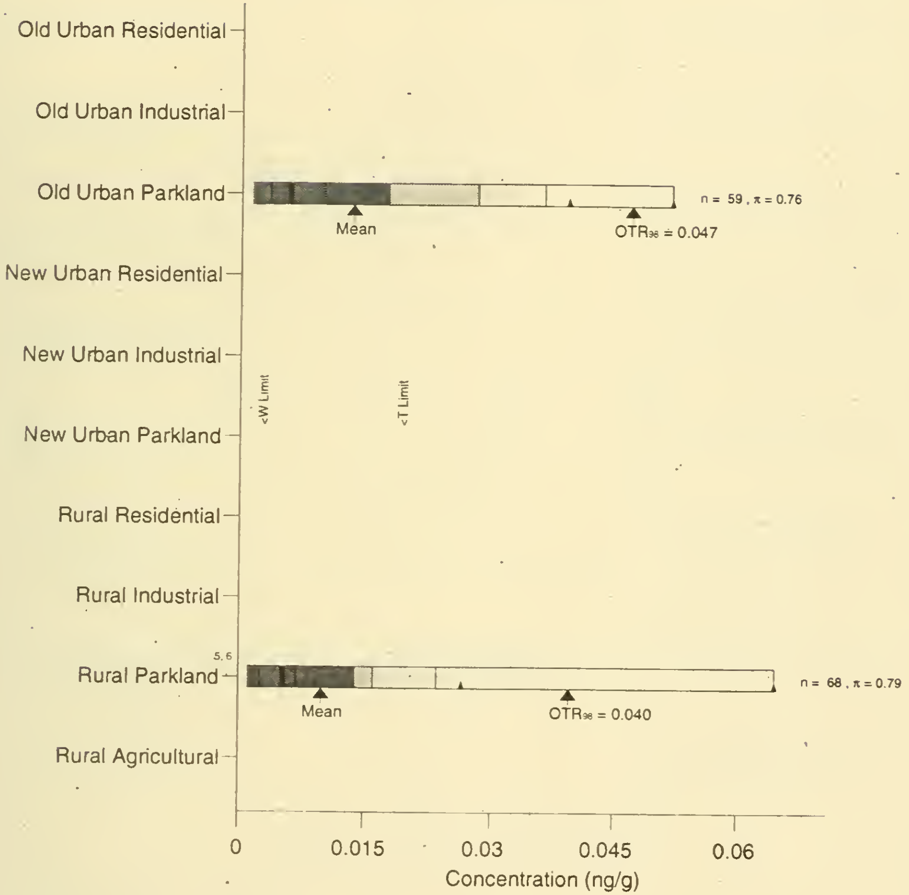


Figure 6.1.46

Ontario Typical Range

Benzene in Class 1 Soils



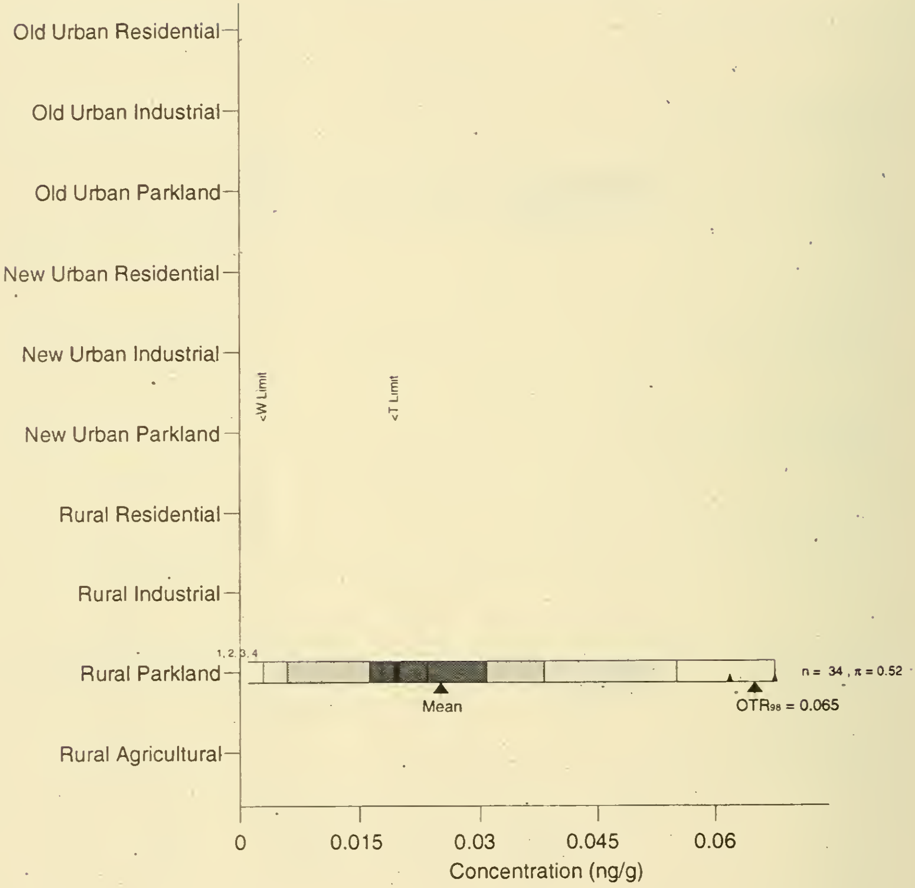
5. Does not include the Northeast Region
6. Does not include the Northwest Region

Figure 6.1.47

Ontario Typical Range

Benzene in Class 1 Soils

(For Regions Rejected by KS Test)

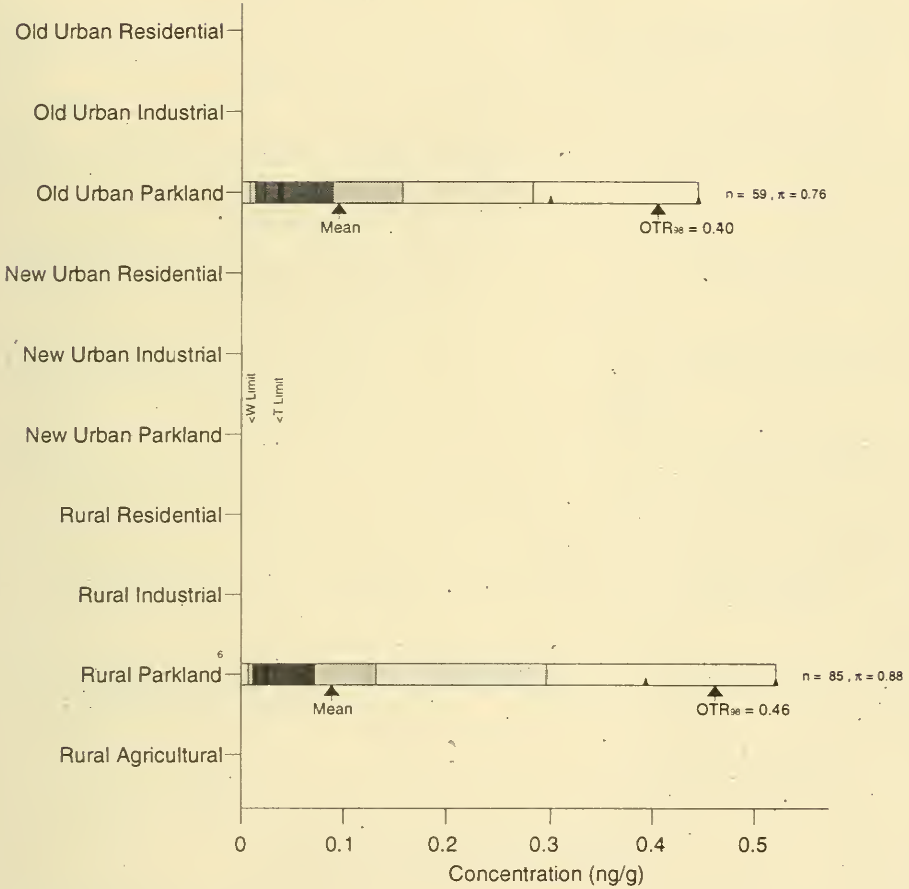


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region

Figure 6.1.48

Ontario Typical Range

Ethylbenzene in Class 1 Soils



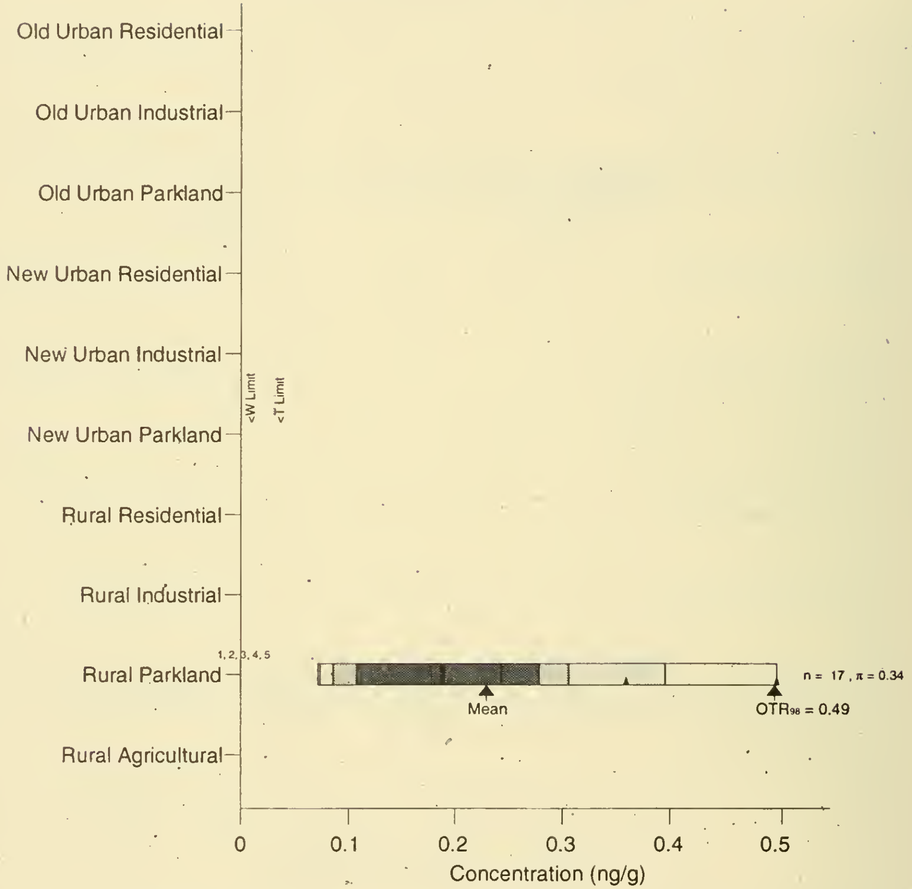
6. Does not include the Northwest Region

Figure 6.1.49

Ontario Typical Range

Ethylbenzene in Class 1 Soils

(For Regions Rejected by KS Test)

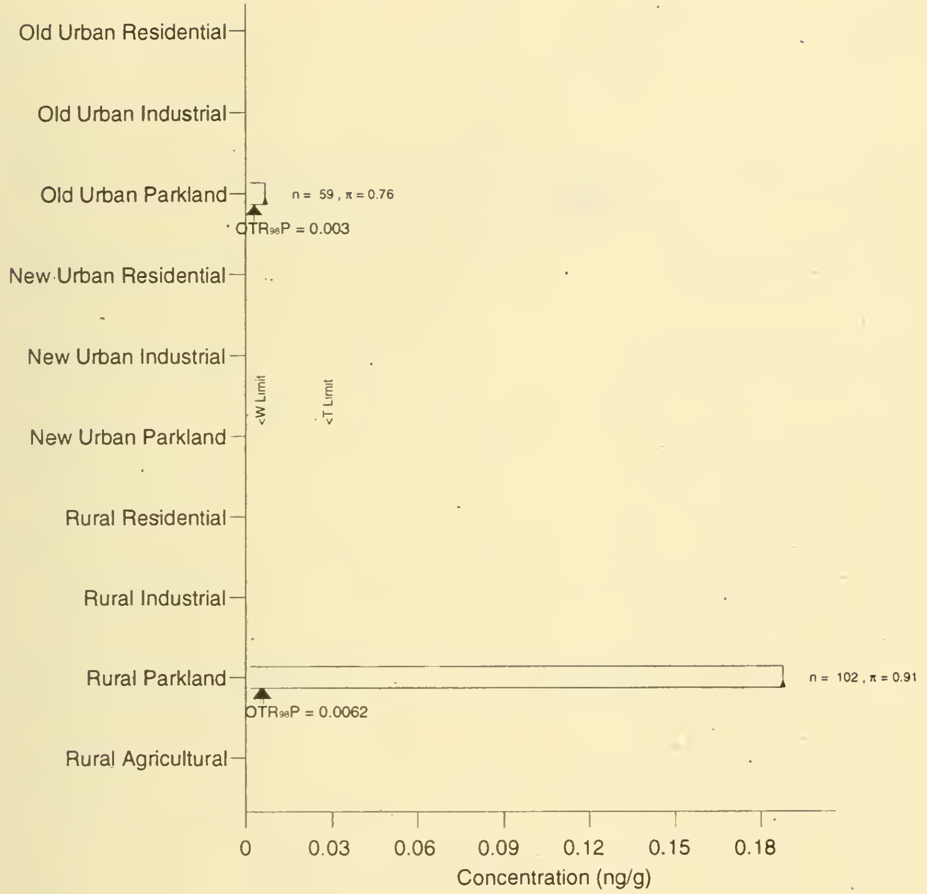


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.50

Ontario Typical Range

Styrene in Class 1 Soils



OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.51

Ontario Typical Range

Toluene in Class 1 Soils

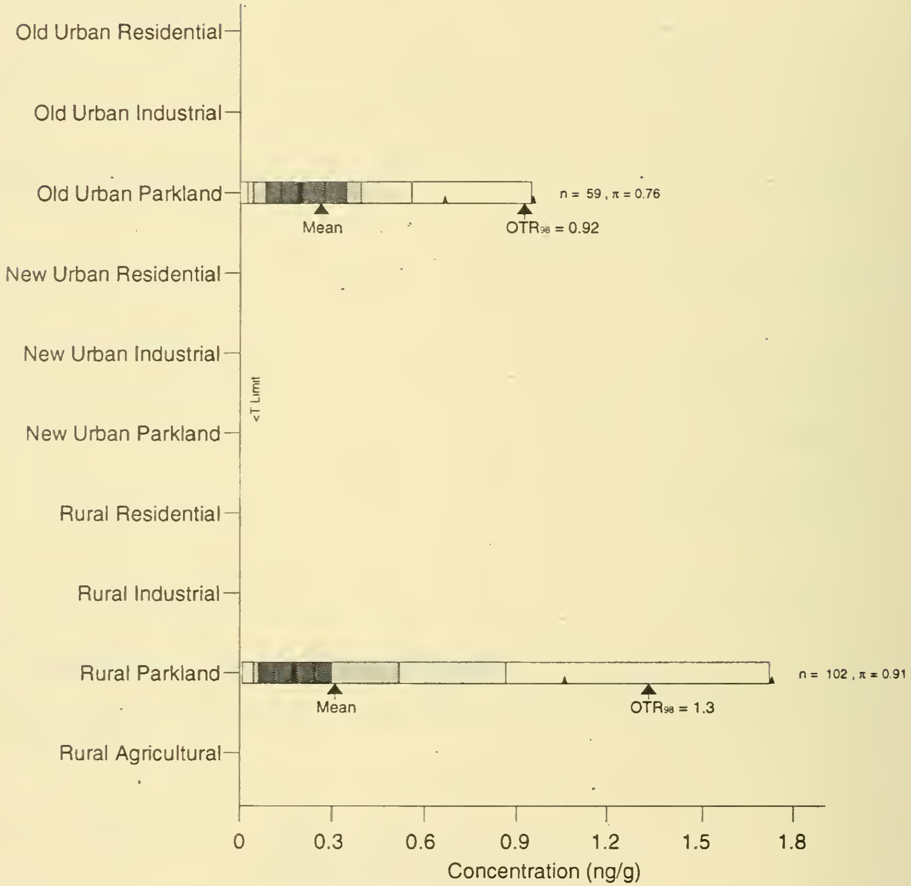


Figure 6.1.52

Ontario Typical Range

m/p-Xylene in Class 1 Soils

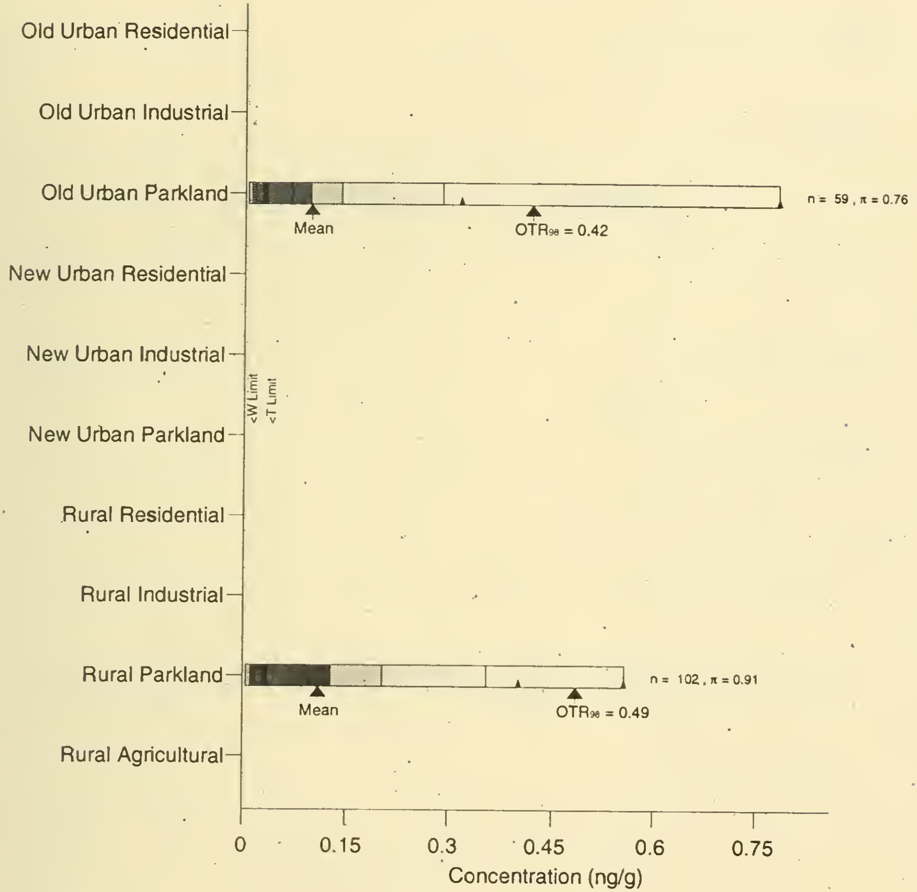


Figure 6.1.53

Ontario Typical Range
o-Xylene in Class 1 Soils

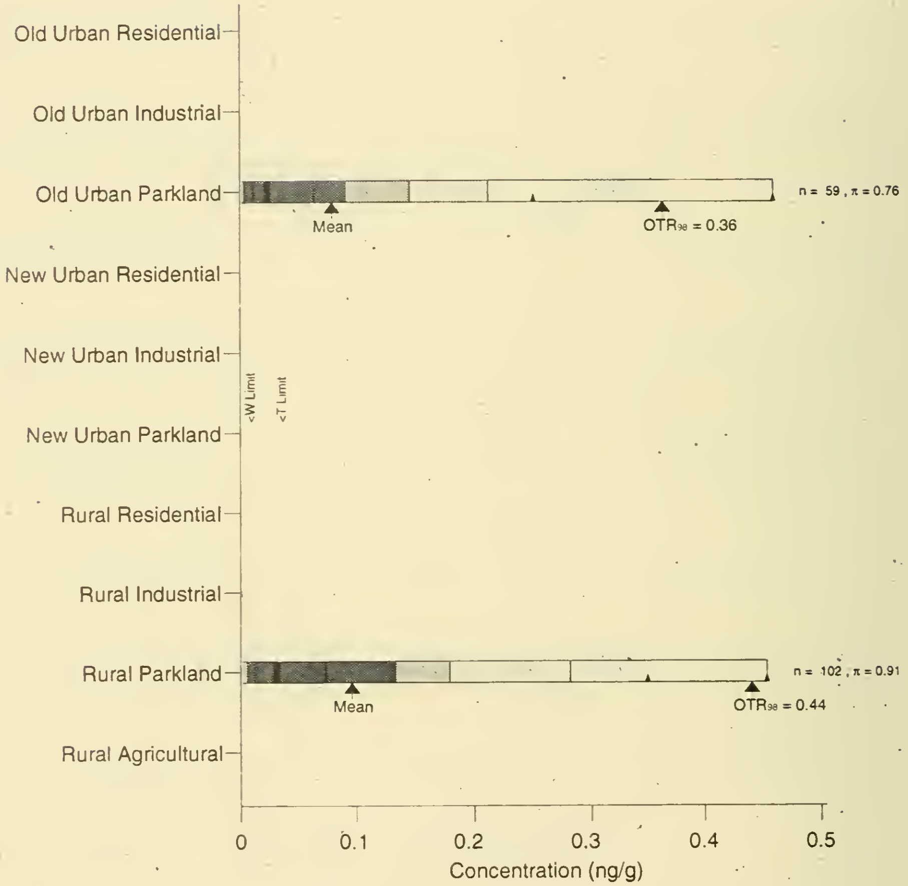


Figure 6.1.54

Ontario Typical Range

Xylene in Class 1 Soils

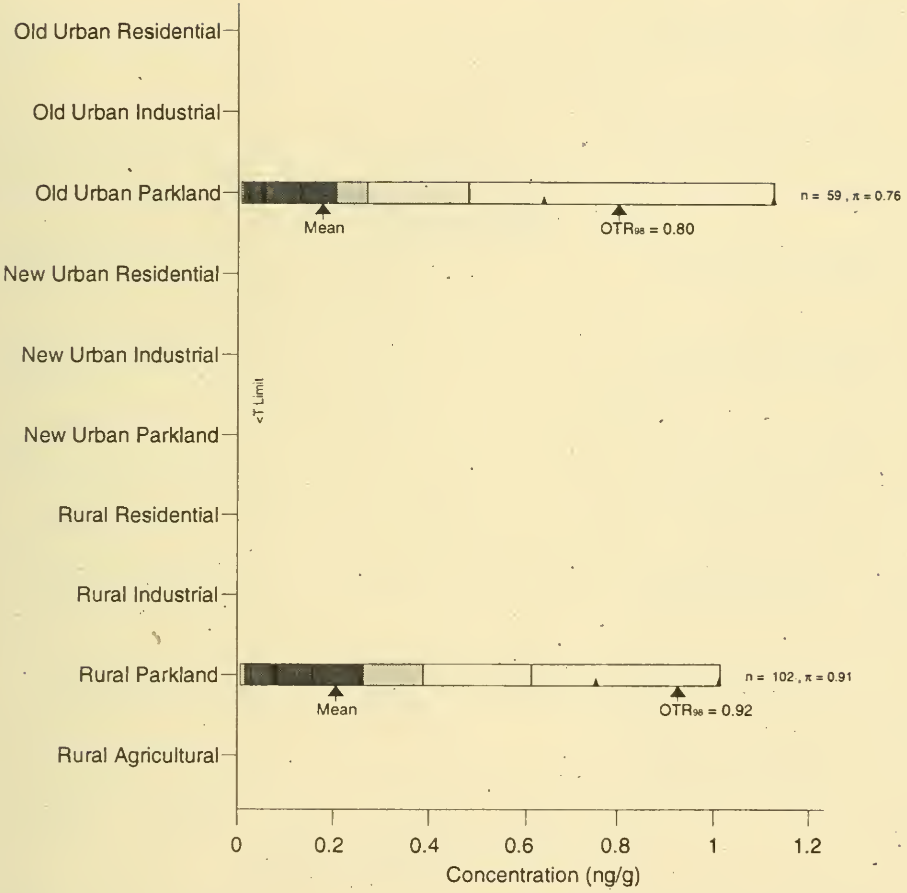
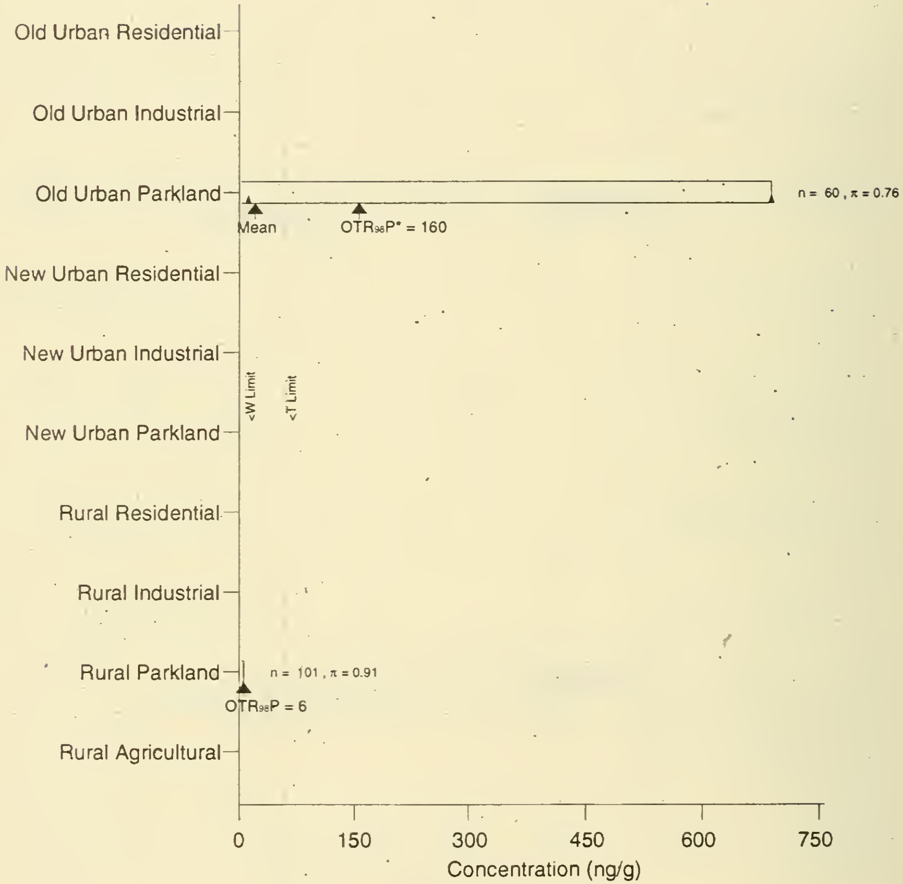


Figure 6.1.55

Ontario Typical Range

Acenapthene in Class 1 Soils



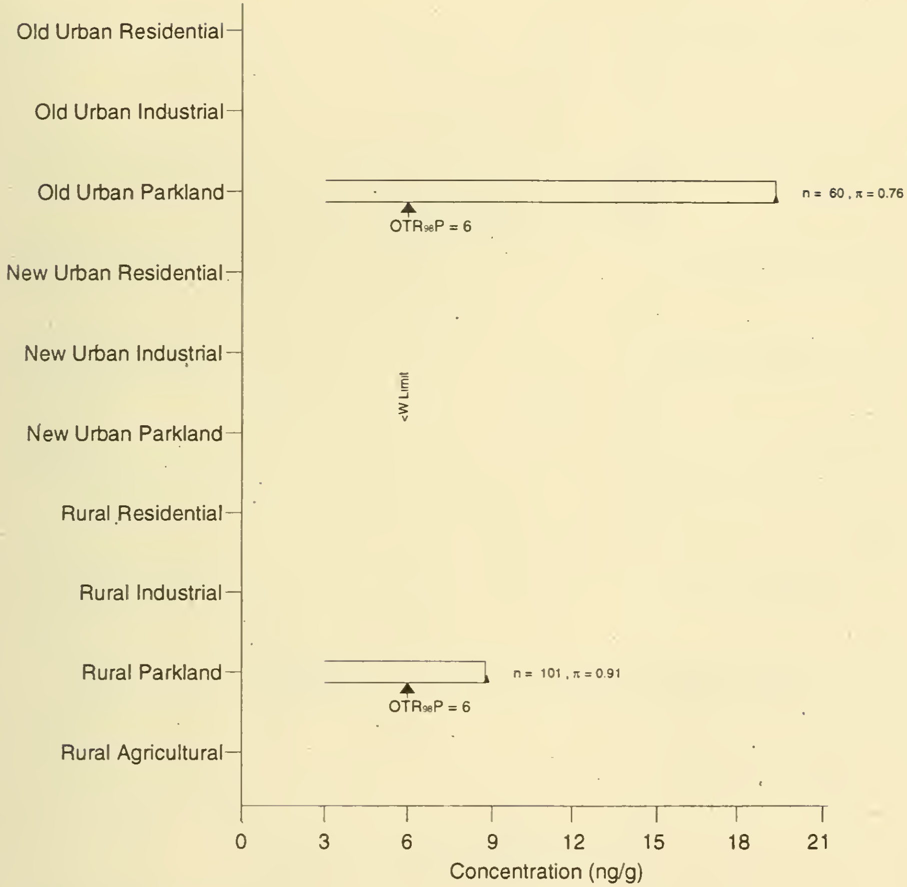
OTR98P - Provisional OTR98 , insufficient data >W

OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.56

Ontario Typical Range

5-Nitroacenaphthene in Class 1 Soils

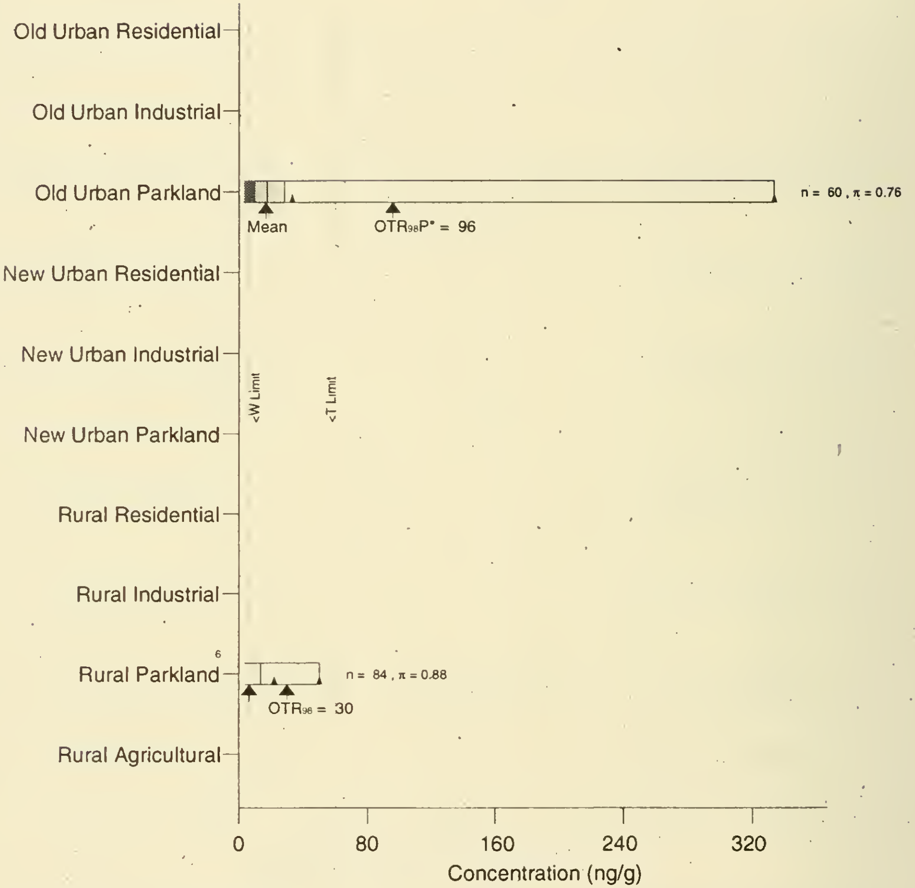


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.57

Ontario Typical Range

Acenapthylene in Class 1 Soils



6. Does not include the Northwest Region

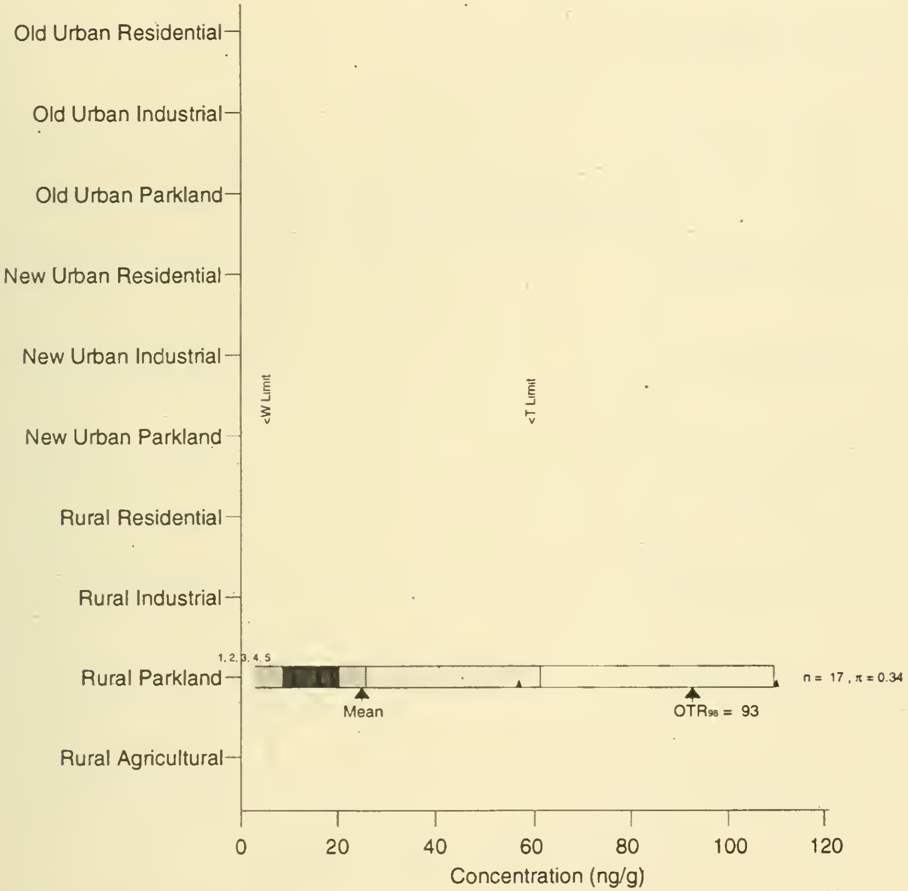
OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.58

Ontario Typical Range

Acenapthylene in Class 1 Soils

(For Regions Rejected by KS Test)

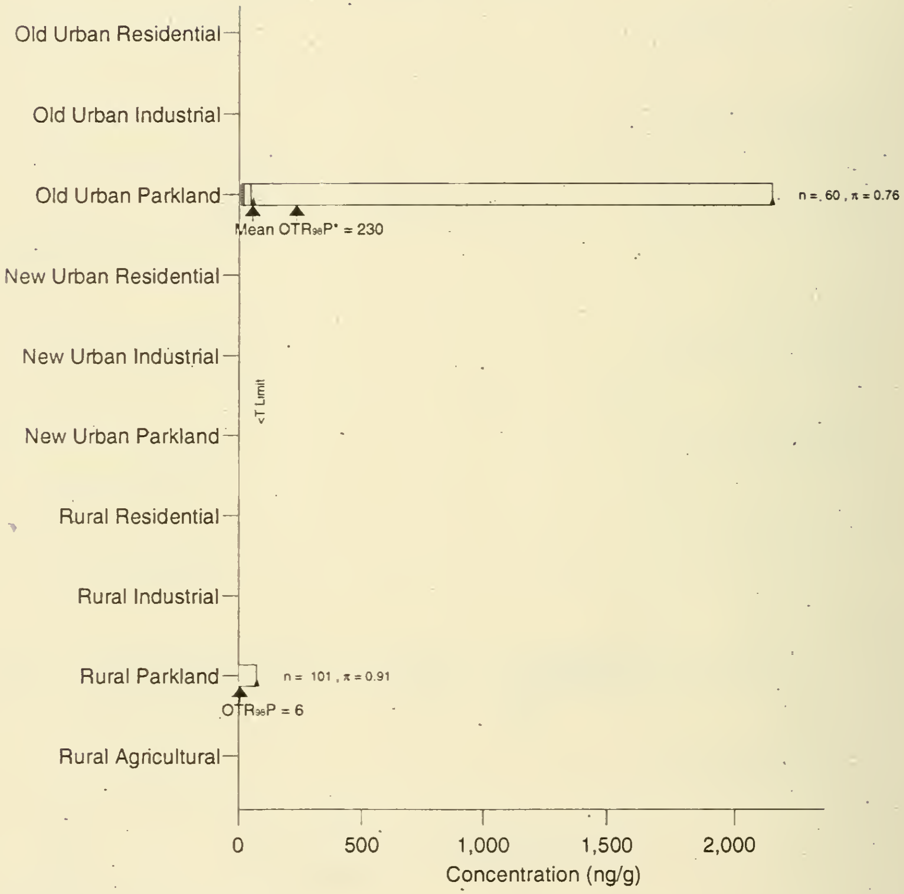


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.59

Ontario Typical Range

Anthracene in Class 1 Soils



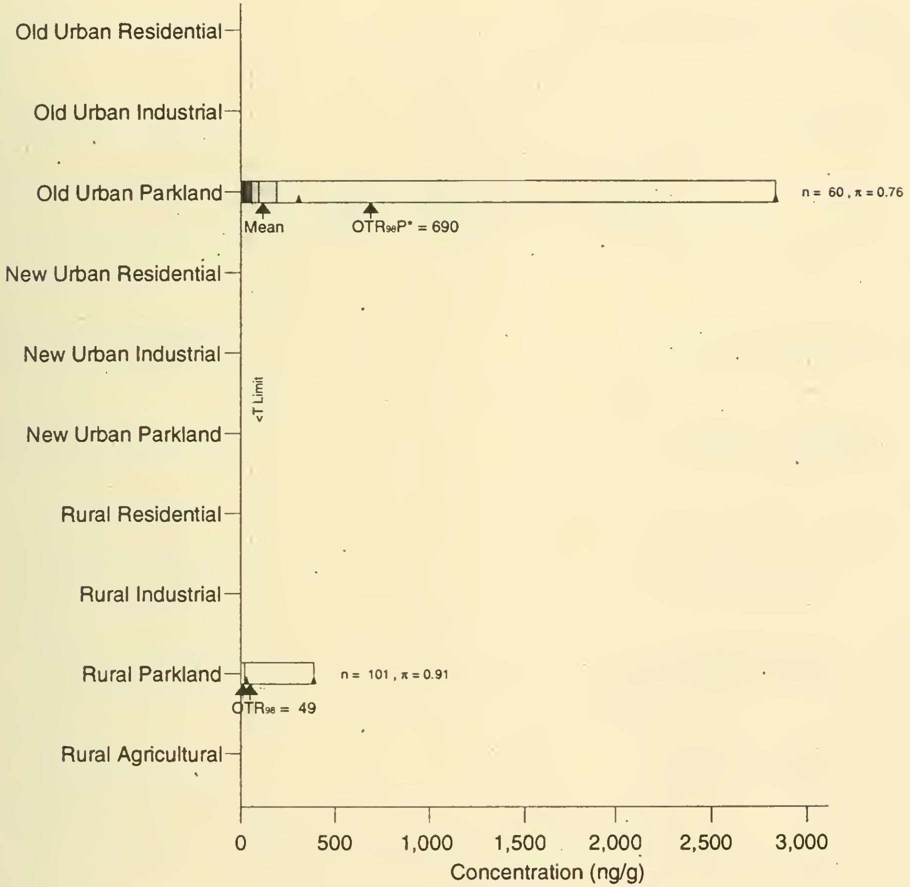
OTR$_{98}$P - Provisional OTR$_{98}$., insufficient data >W

OTR$_{98}$P* - *Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.60

Ontario Typical Range

Benzo(a)anthracene in Class 1 Soils

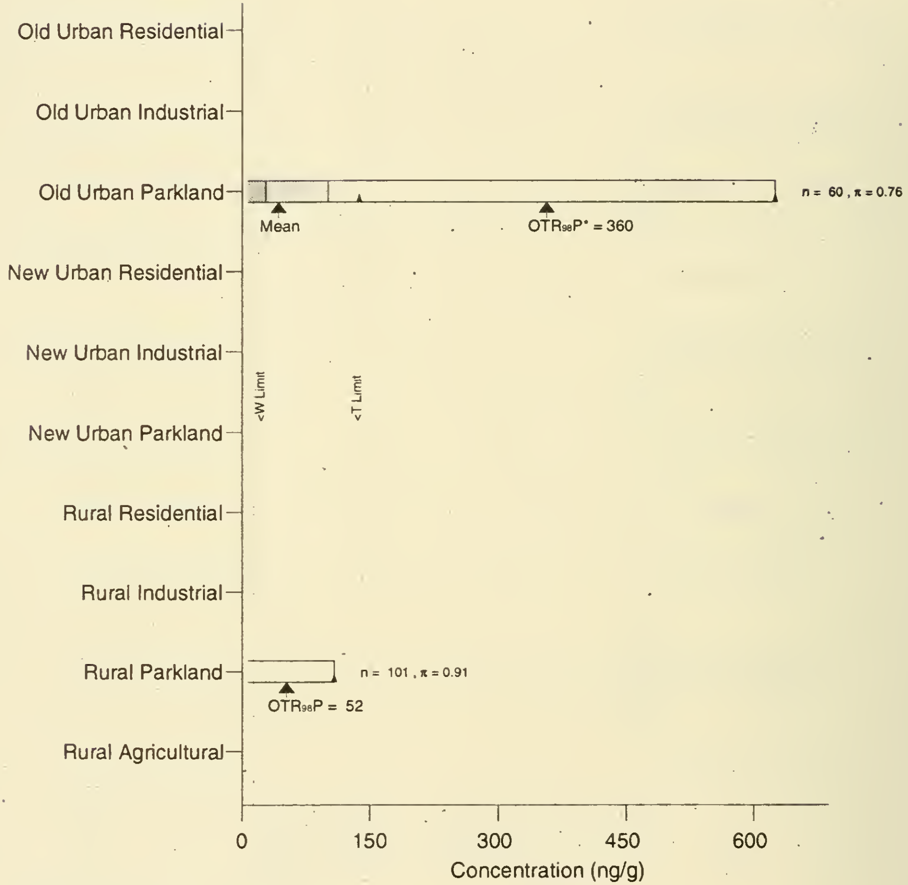


OTR98P*- *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.61

Ontario Typical Range

Dibenzo(a,h)anthracene in Class 1 Soils



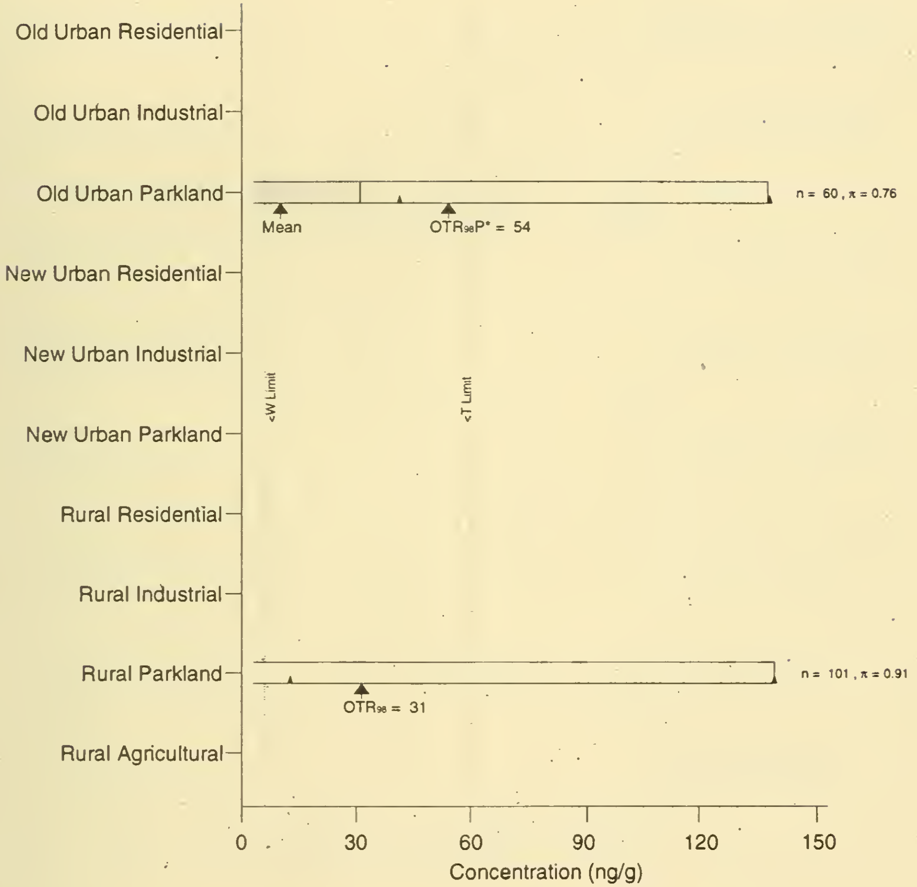
OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

OTR$_{98}$P* - *Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this tima.*

Figure 6.1.62

Ontario Typical Range

Camphene in Class 1 Soils

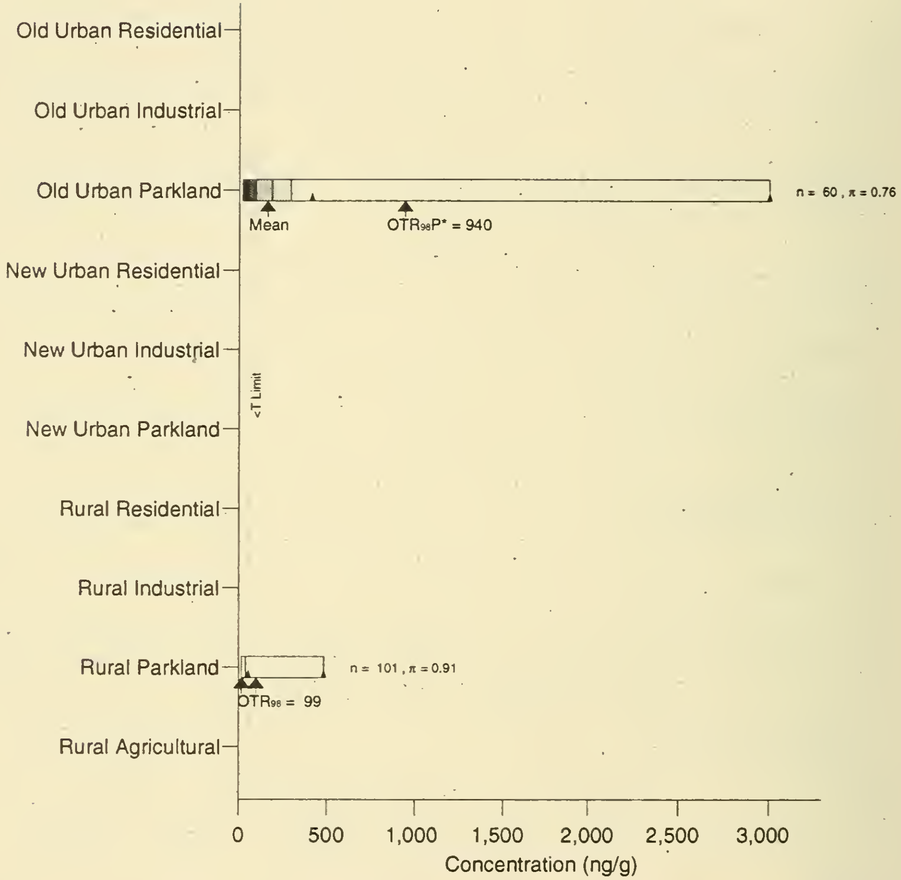


OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.63

Ontario Typical Range

Chrysene in Class 1 Soils

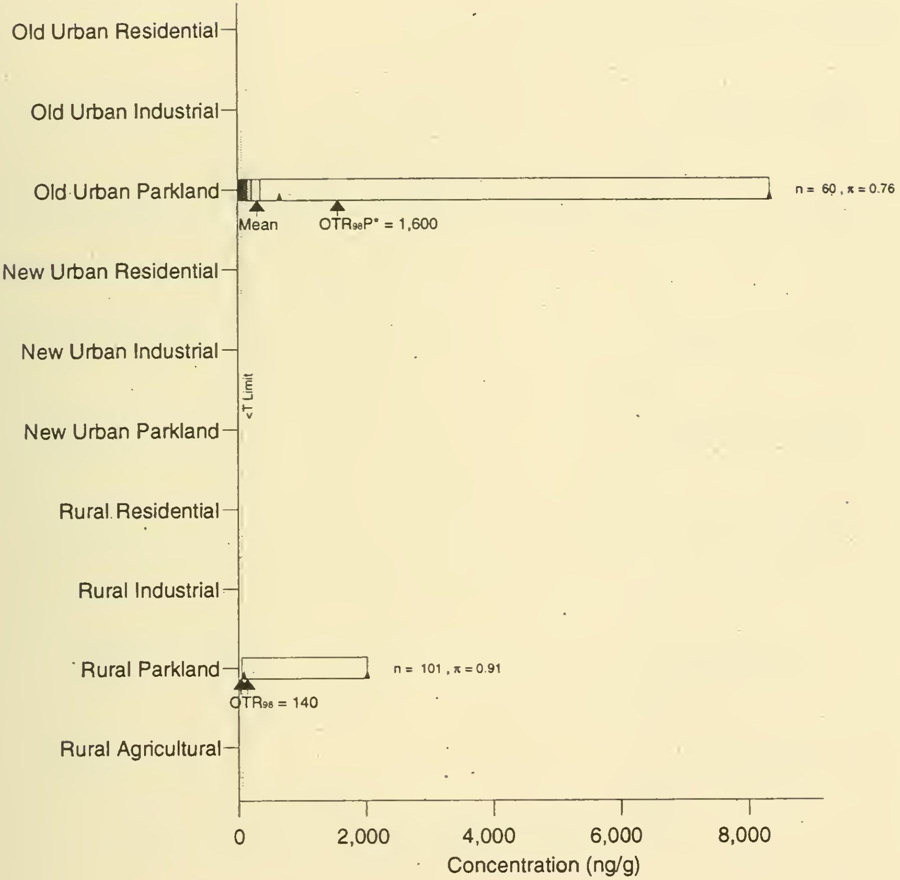


OTR$_{98}$P* - *Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.64

Ontario Typical Range

Fluoranthene in Class 1 Soils

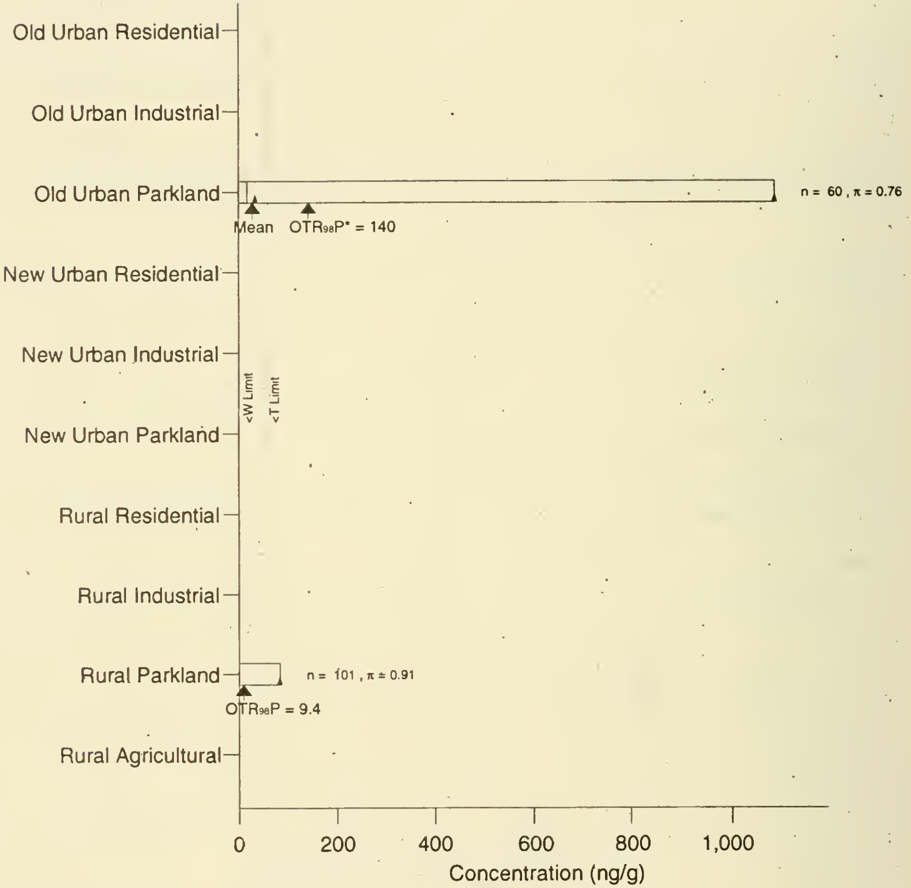


OTR$_{98}$P* - *Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.65

Ontario Typical Range

Fluorene in Class 1 Soils



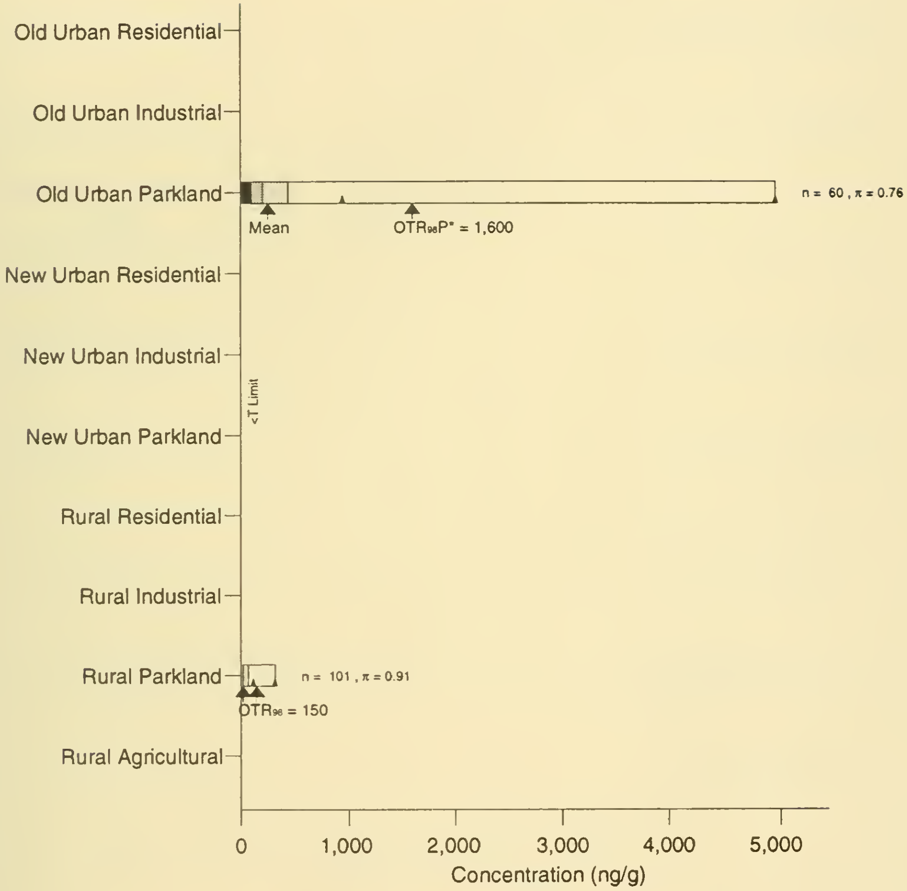
OTR98P - Provisional OTR98 , insufficient data >W

OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.66

Ontario Typical Range

Benzo(b)fluoranthene in Class 1 Soils

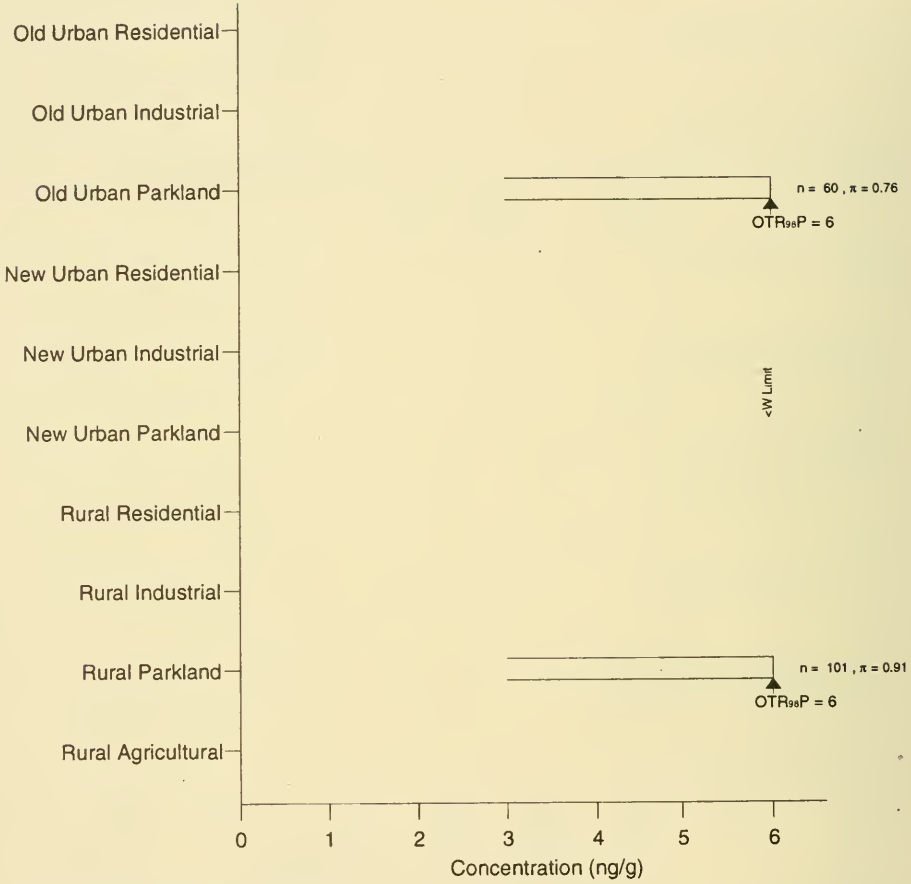


$OTR_{98}P^*$ - *Provisional OTR_{98}, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.67

Ontario Typical Range

Benzo(k)fluoranthene in Class 1 Soils

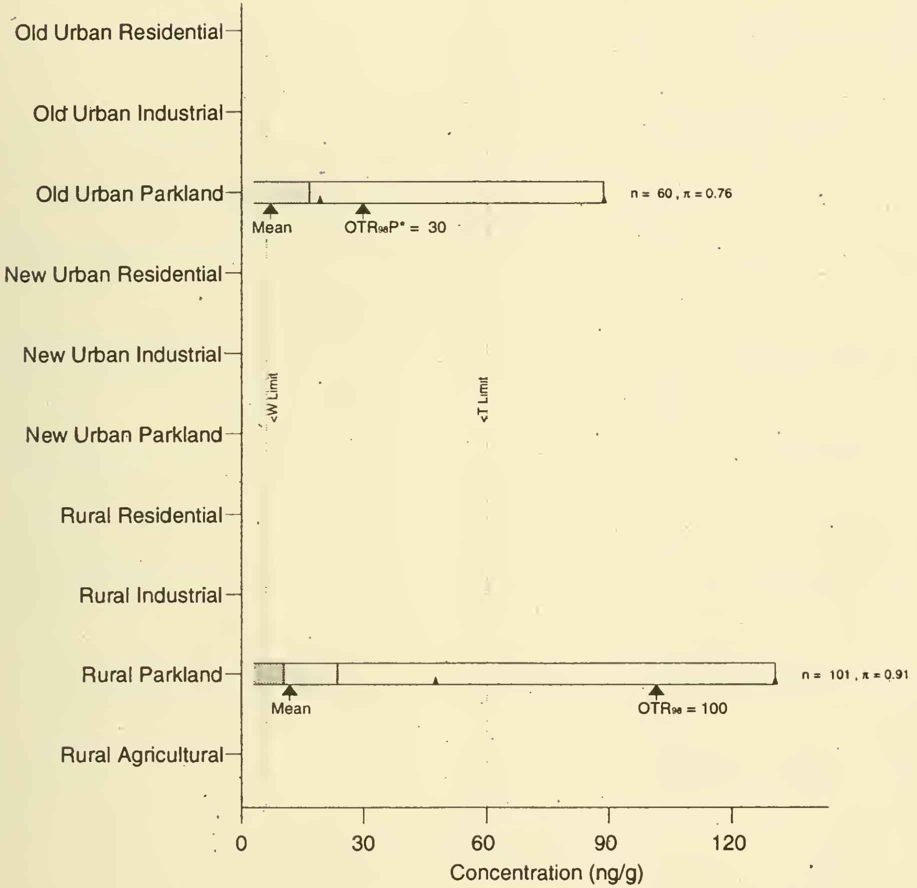


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.68

Ontario Typical Range

Indole in Class 1 Soils

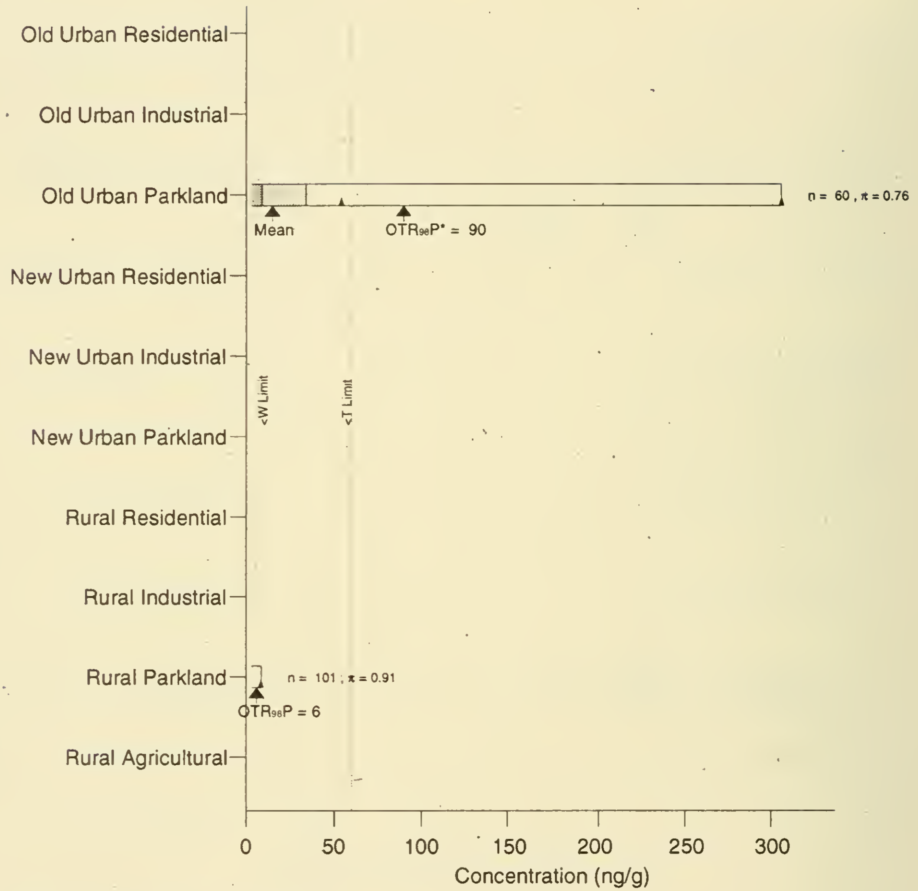


$OTR_{98}P^*$ - ***Provisional OTR_{98} , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.***

Figure 6.1.69

Ontario Typical Range

Naphthalene in Class 1 Soils



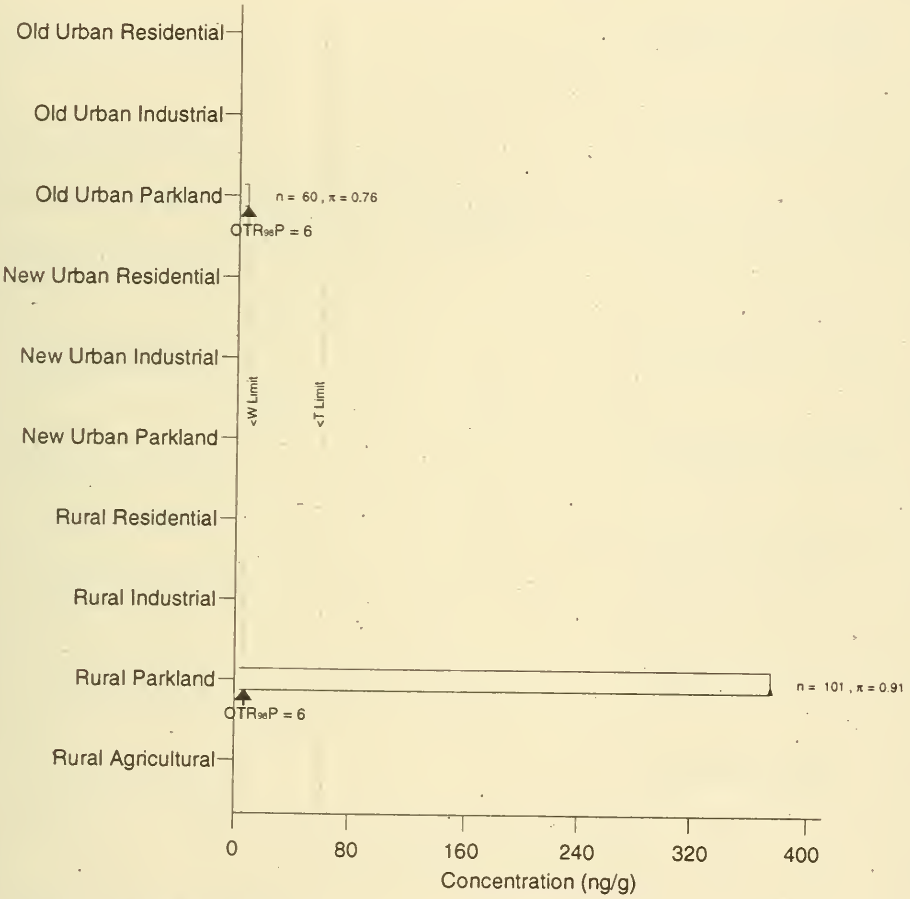
OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

OTR$_{98}$P* - ***Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.***

Figure 6.1.70

Ontario Typical Range

1-Chloronapthalene in Class 1 Soils

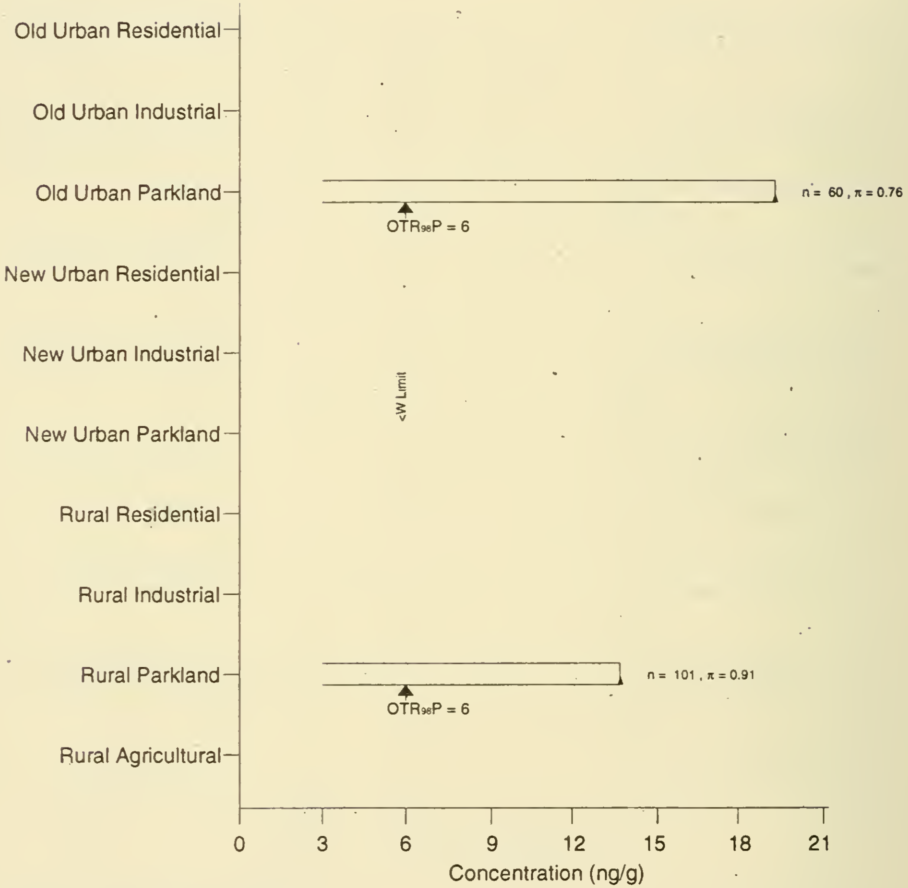


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.71

Ontario Typical Range

2-Chloronaphthalene in Class 1 Soils

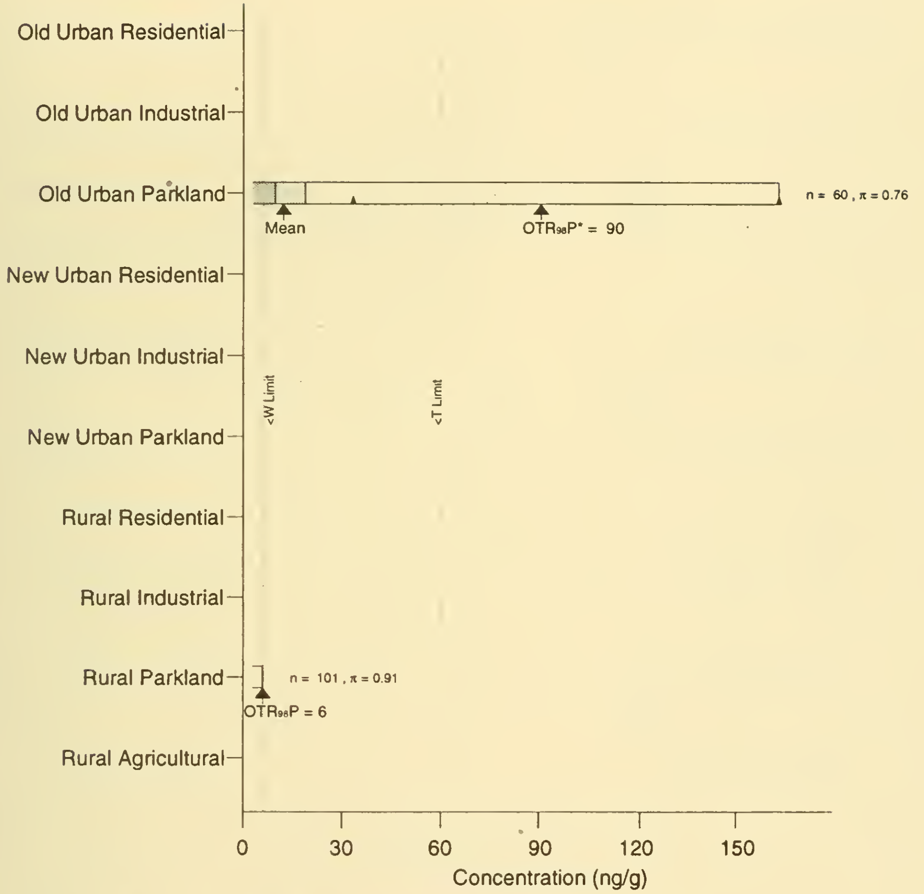


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.72

Ontario Typical Range

1-Methylnapthalene in Class 1 Soils



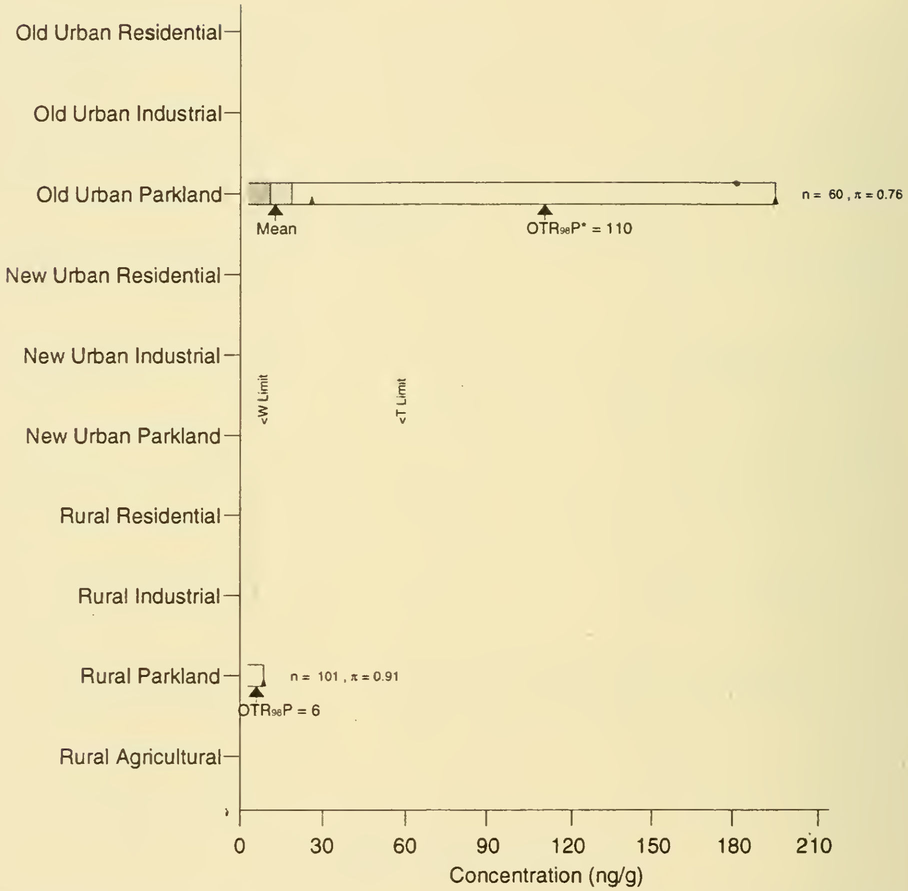
OTR98P - Provisional OTR98 , insufficient data >W

OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.73

Ontario Typical Range

2-Methylnapthalene in Class 1 Soils



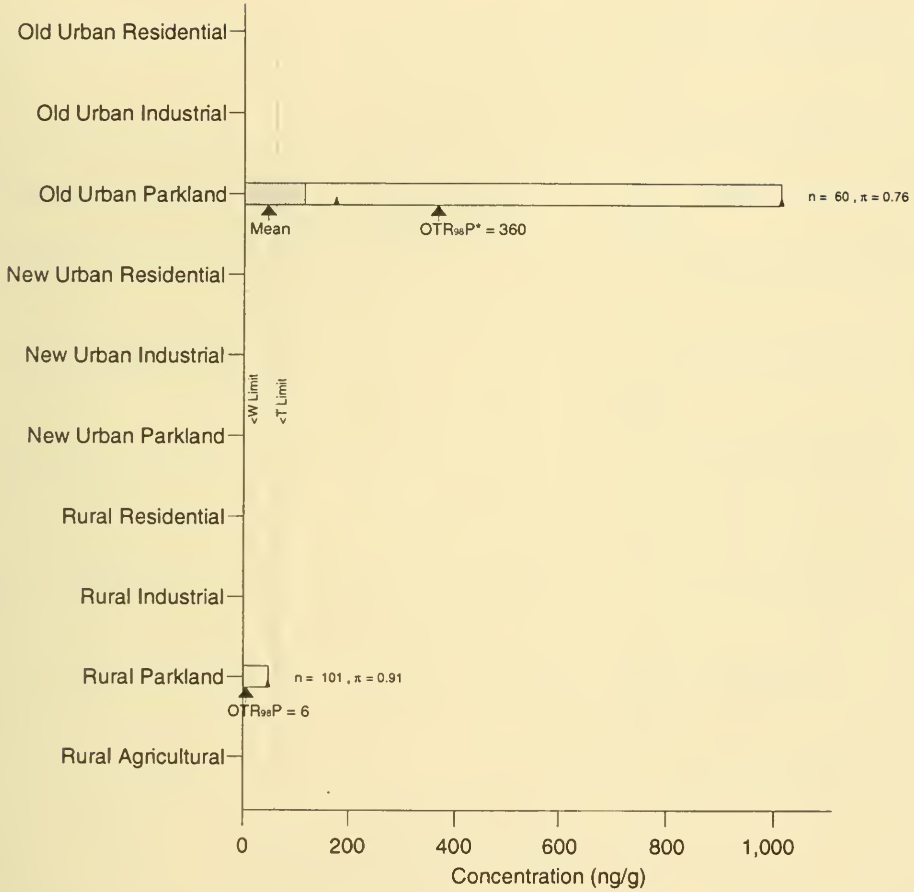
$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

$OTR_{98}P^*$- *Provisional OTR_{98} , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this tima.*

Figure 6.1.74

Ontario Typical Range

Perylene in Class 1 Soils



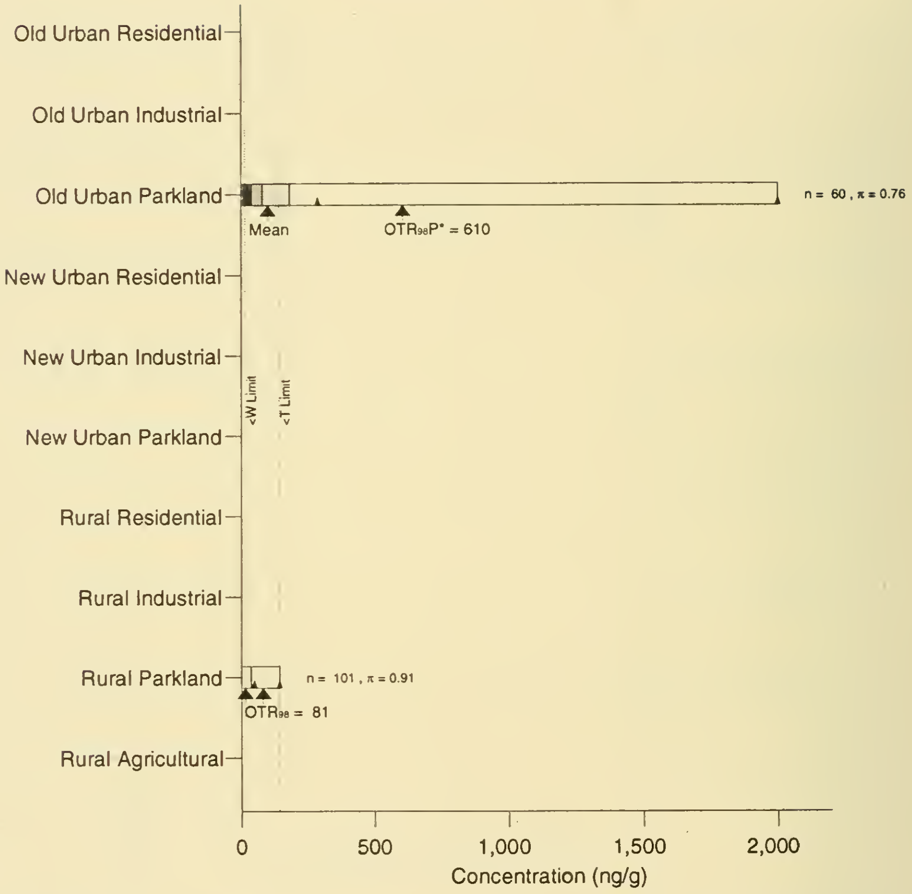
OTR98P - Provisional OTR98, insufficient data >W

OTR98P* - *Provisional OTR98, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.75

Ontario Typical Range

Benzo(g,h,i)perylene in Class 1 Soils

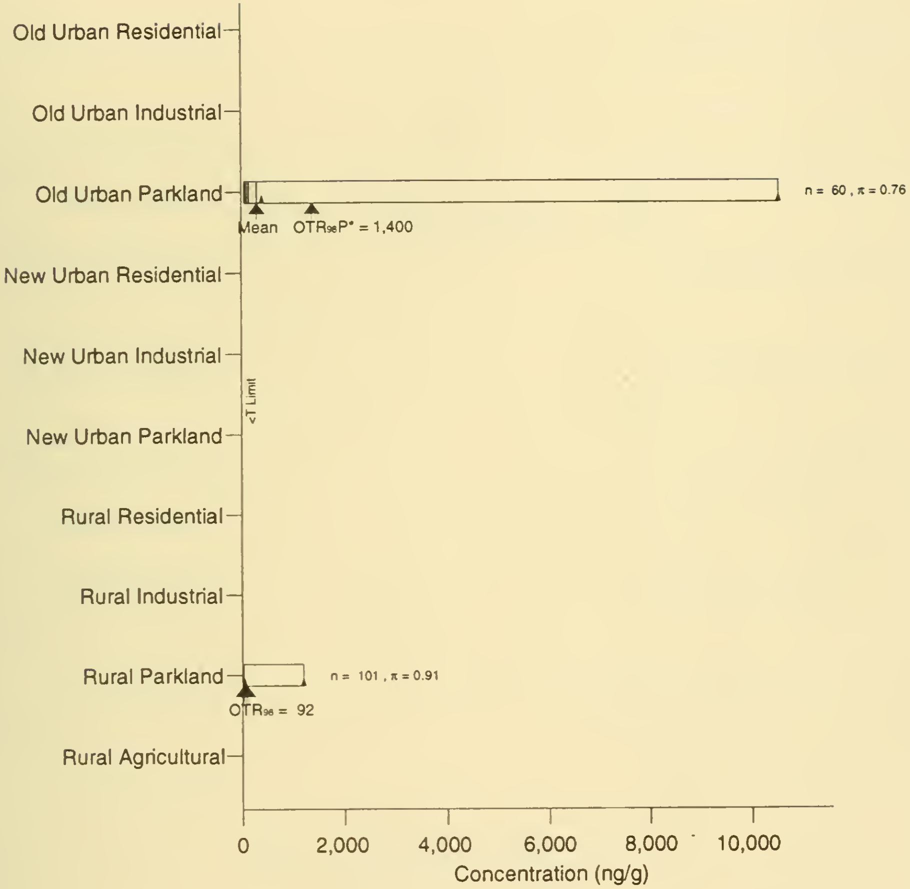


OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.76

Ontario Typical Range

Phenanthrene in Class 1 Soils

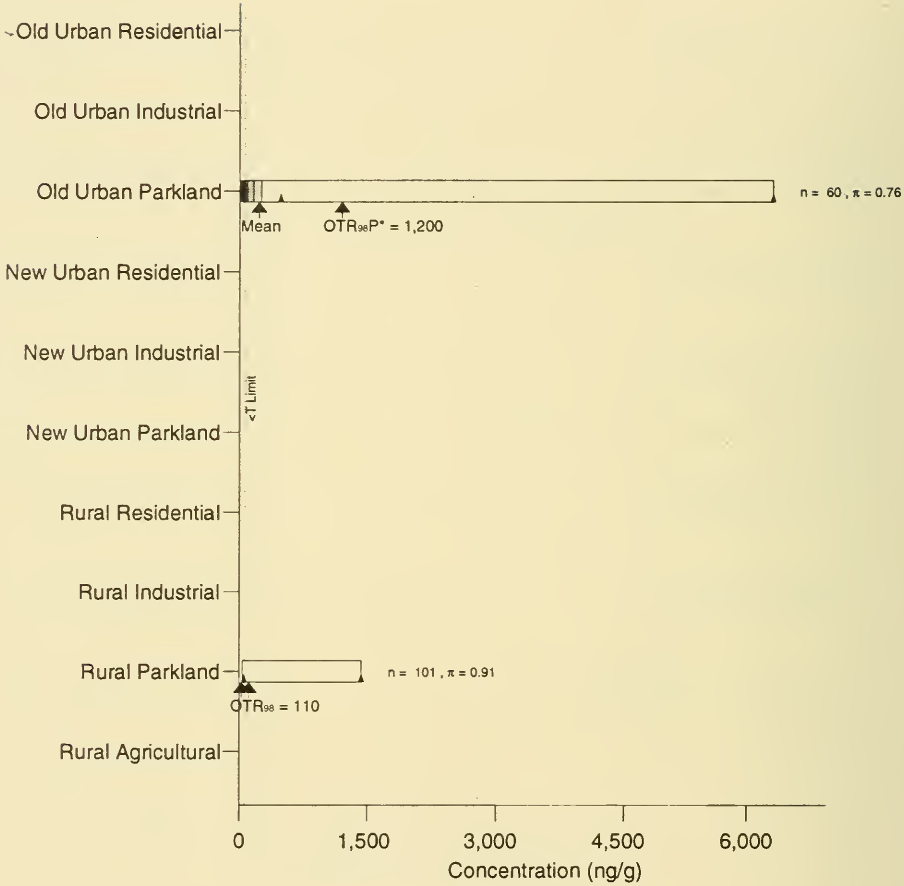


OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.77

Ontario Typical Range

Pyrene in Class 1 Soils

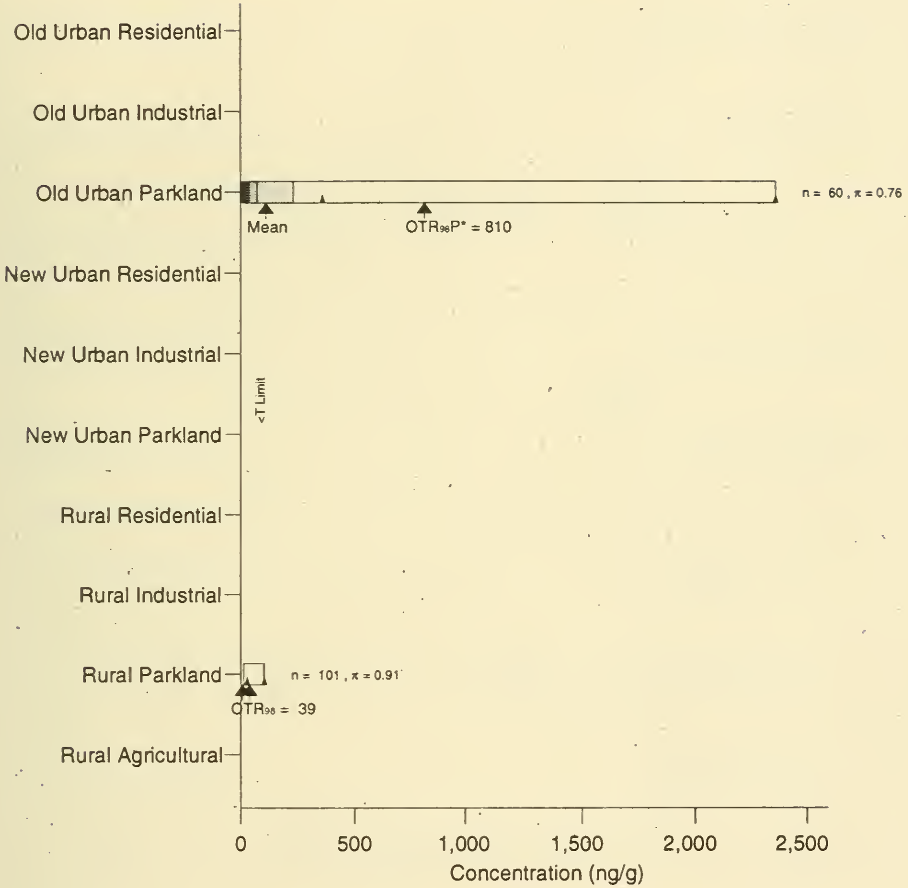


OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.78

Ontario Typical Range

Benzo(a)pyrene in Class 1 Soils

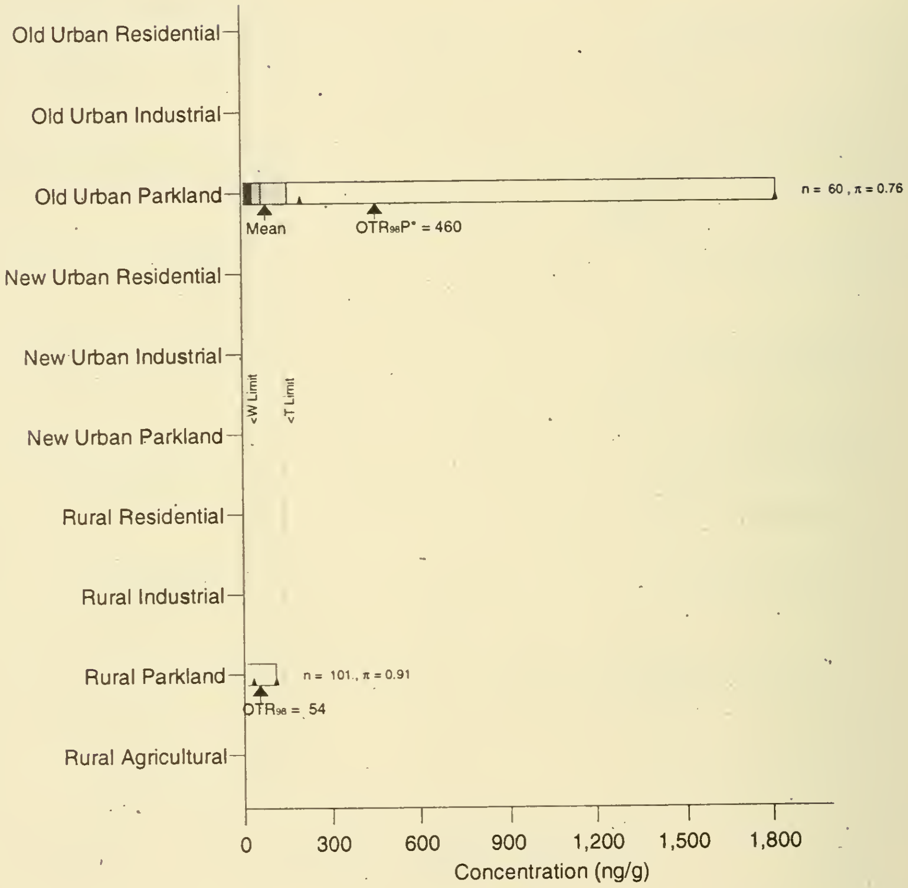


OTR$_{98}$P* - *Provisional OTR$_{98}$, because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.79

Ontario Typical Range

Indeno(1,2,3-cd)pyrene in Class 1 Soils

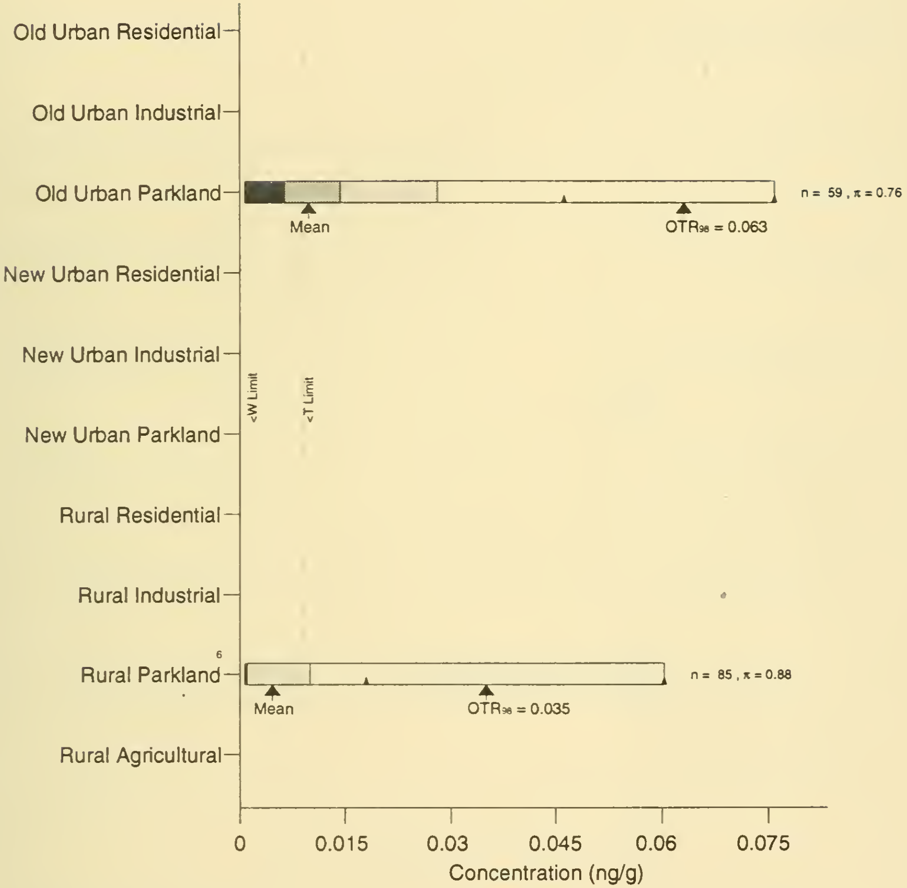


OTR98P* - *Provisional OTR98 , because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH ar being designated as Provisional at this time.*

Figure 6.1.80

Ontario Typical Range

Chlorobenzene in Class 1 Soils



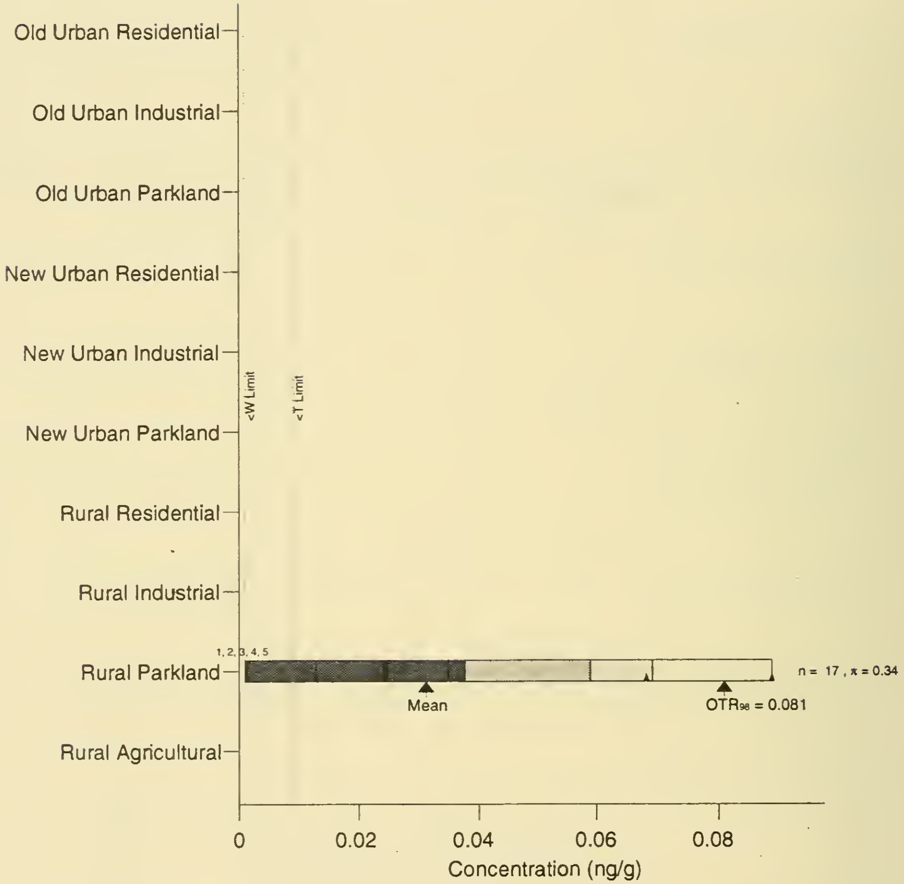
6. Does not include the Northwest Region

Figure 6.1.81

Ontario Typical Range

Chlorobenzene in Class 1 Soils

(For Regions Rejected by KS Test)

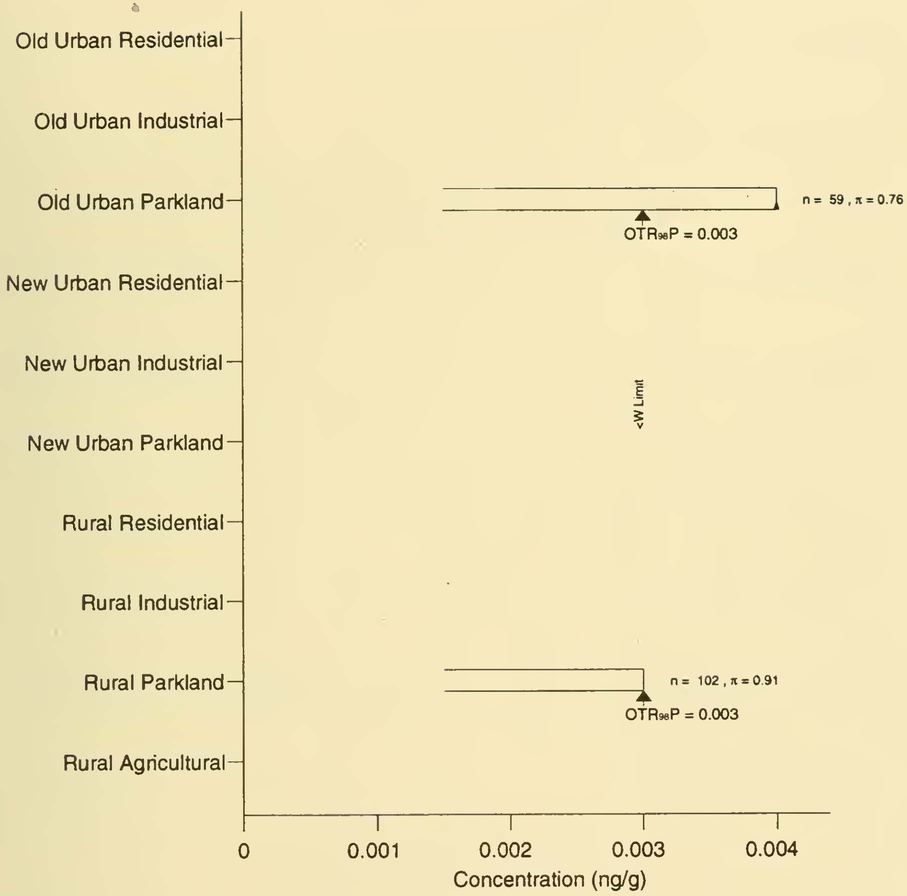


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.82

Ontario Typical Range

1,2-Dichlorobenzene in Class 1 Soils

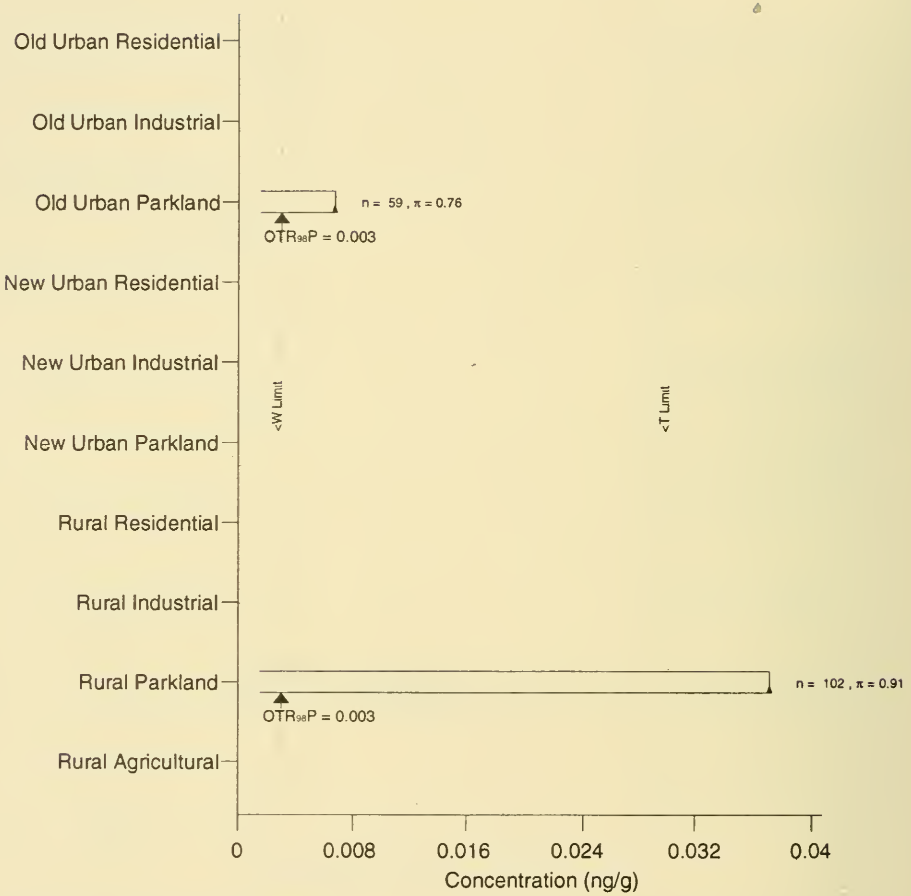


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.83

Ontario Typical Range

1,3-Dichlorobenzene in Class 1 Soils

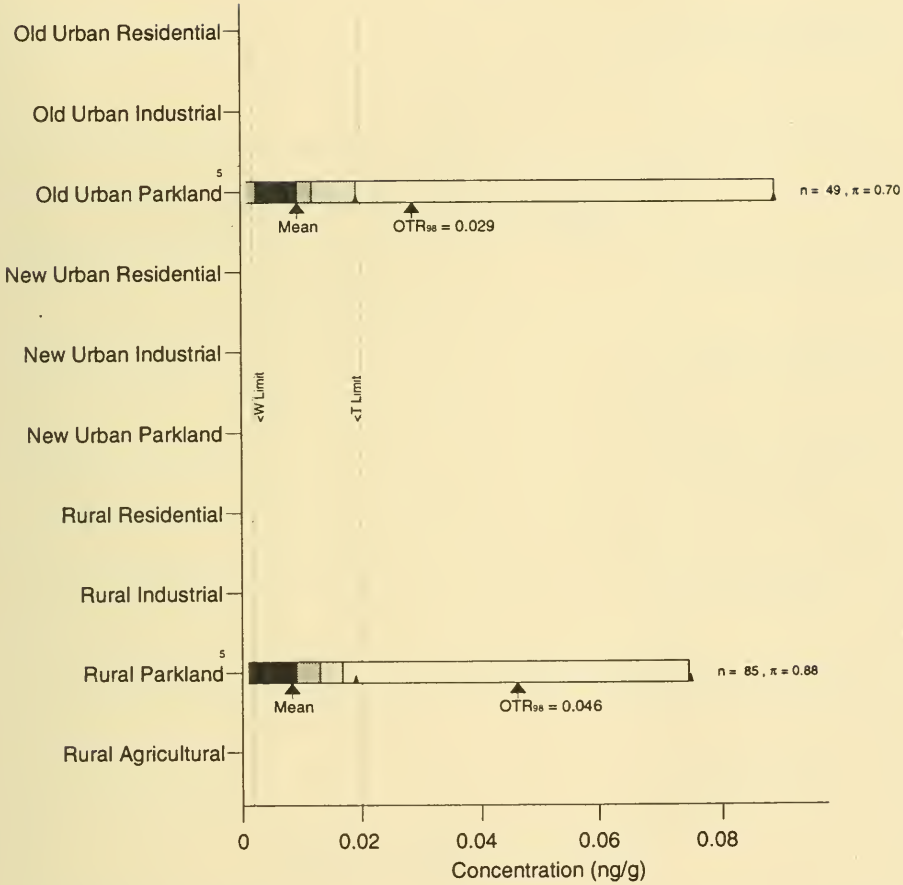


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.84

Ontario Typical Range

1,4-Dichlorobenzene in Class 1 Soils



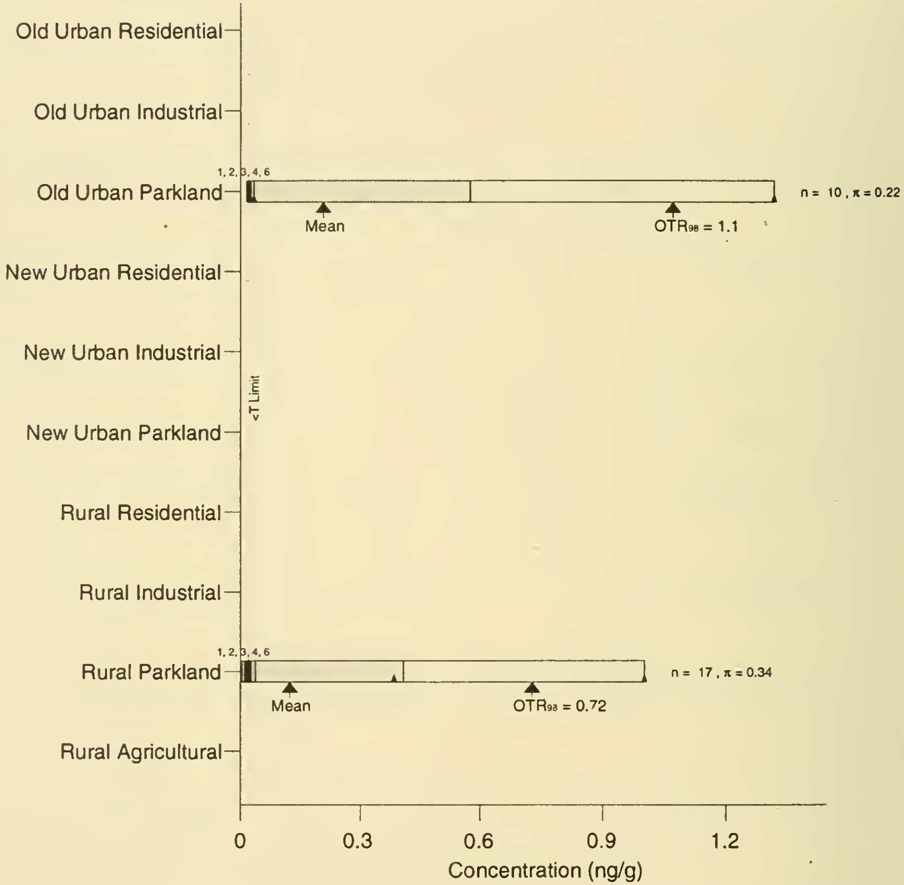
5. Does not include the Northeast Region

Figure 6.1.85

Ontario Typical Range

1,4-Dichlorobenzene in Class 1 Soils

(For Regions Rejected by KS Test)

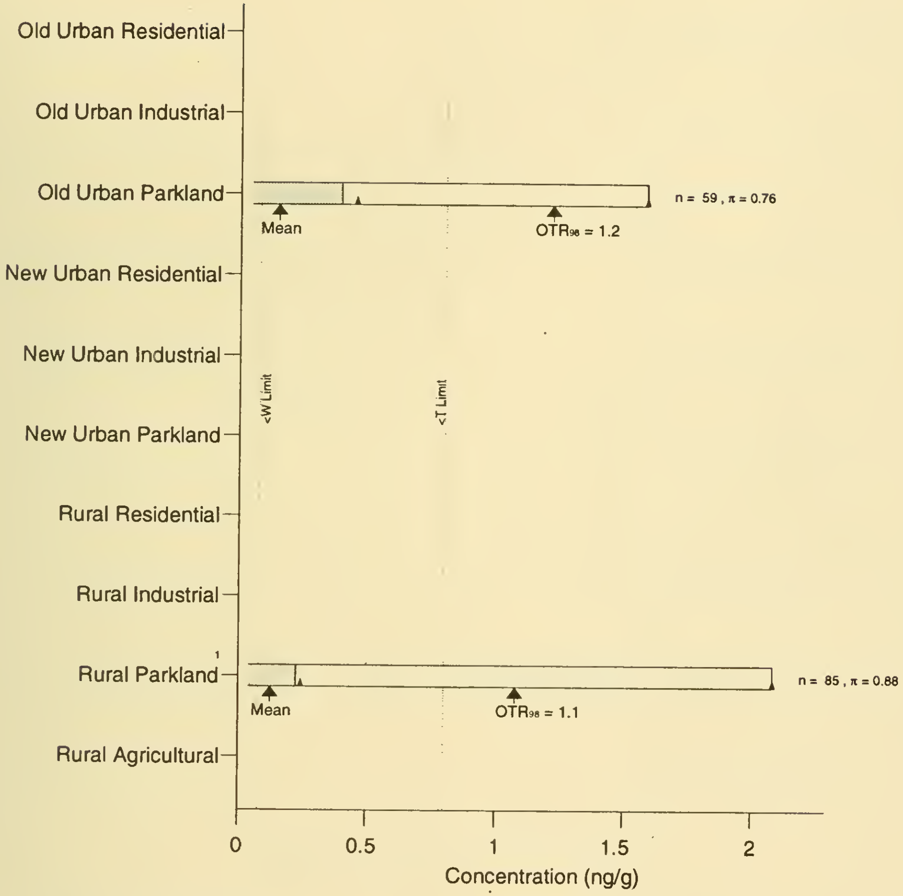


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
6. Does not include the Northwest Region

Figure 6.1.86

Ontario Typical Range

Bromomethane in Class 1 Soils



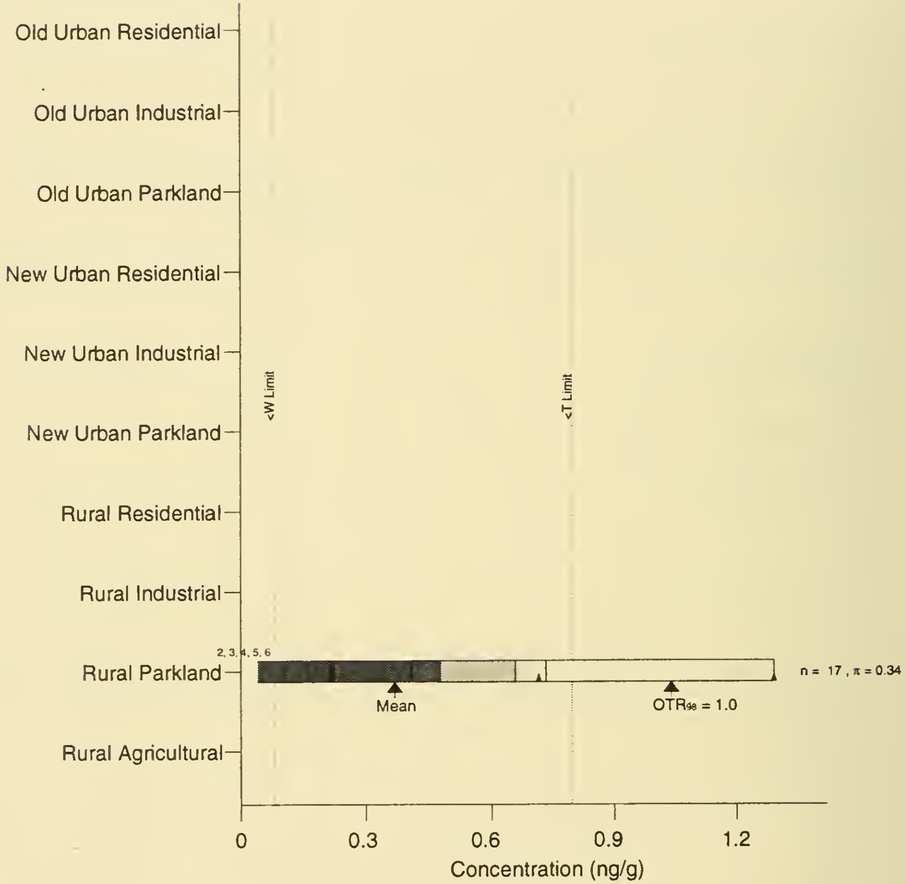
1. Does not include the Southwest Region

Figure 6.1.87

Ontario Typical Range

Bromomethane in Class 1 Soils

(For Regions Rejected by KS Test)



2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region
6. Does not include the Northwest Region

Figure 6.1.88

Ontario Typical Range

Dibromochloromethane in Class 1 Soils

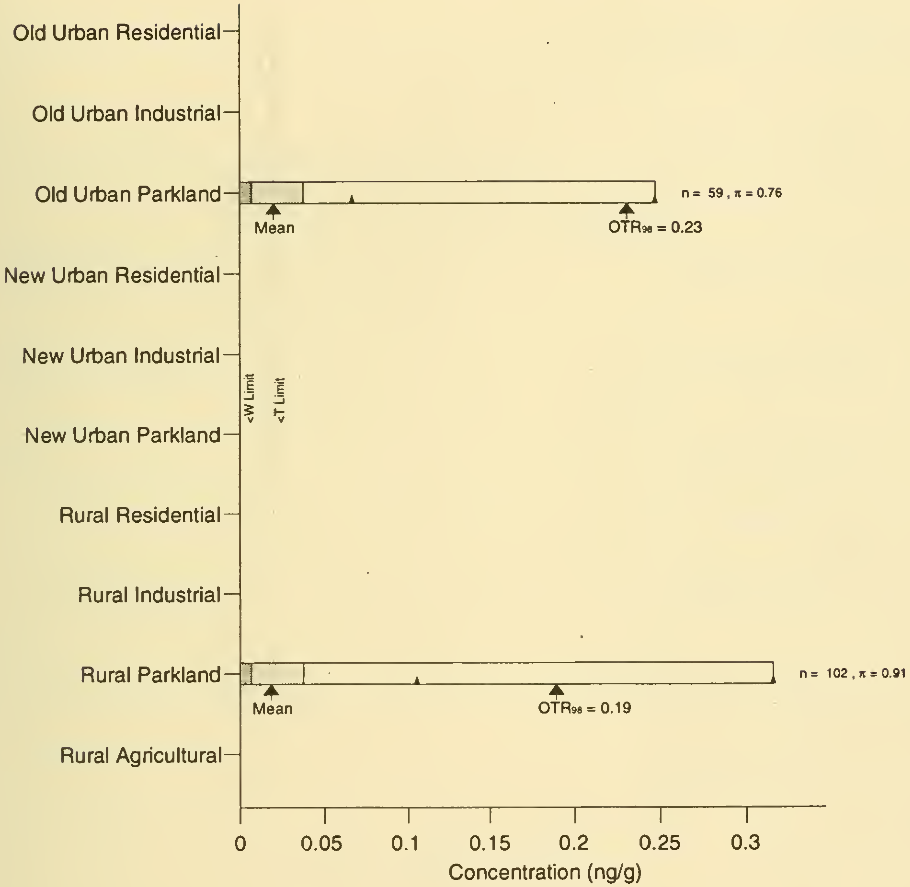


Figure 6.1.89

Ontario Typical Range

1,2-Dibromoethane in Class 1 Soils

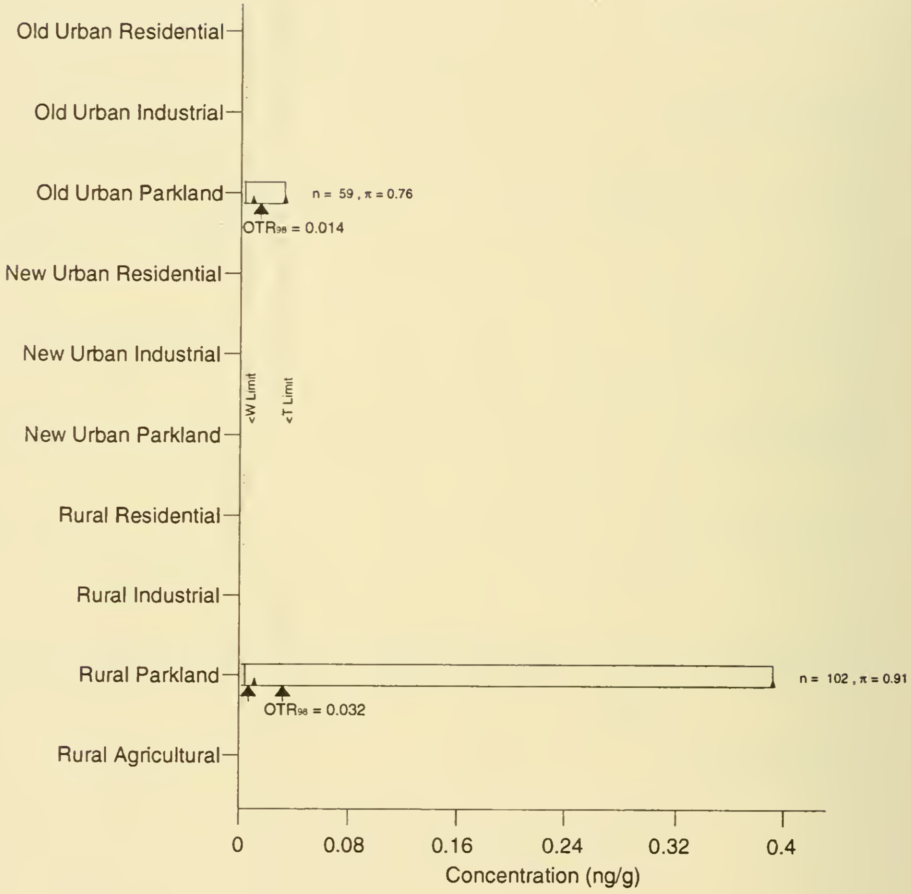
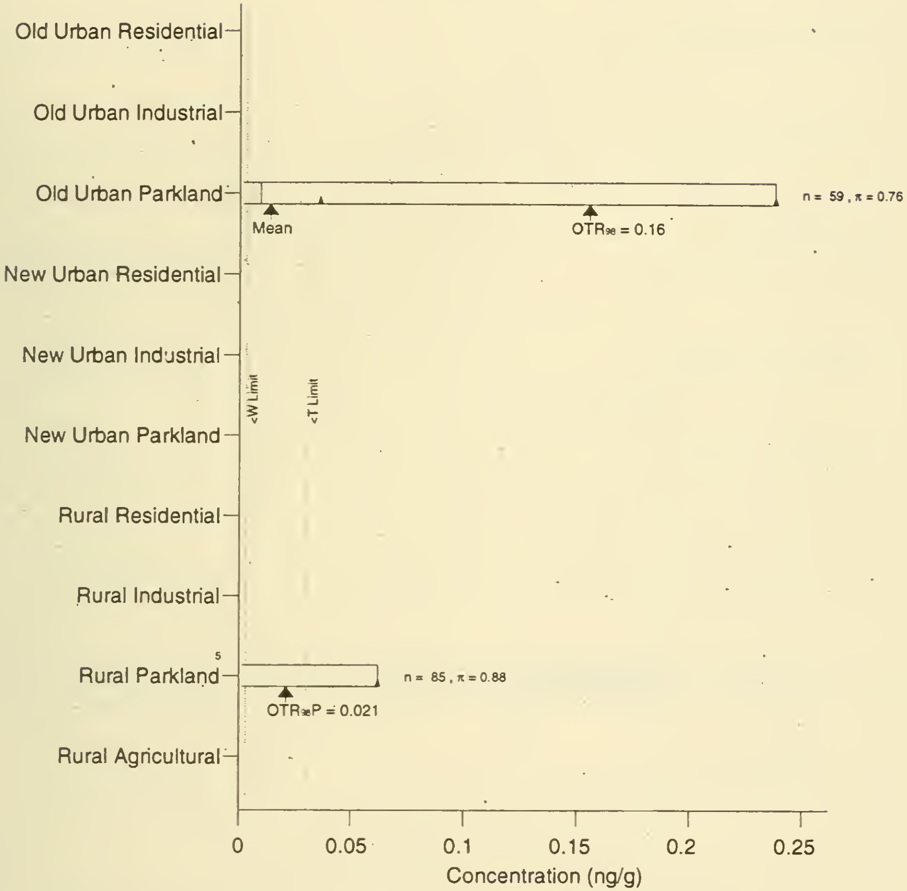


Figure 6.1.90

Ontario Typical Range

Tribromomethane (Bromoform) in Class 1 Soils



5. Does not include the Northeast Region

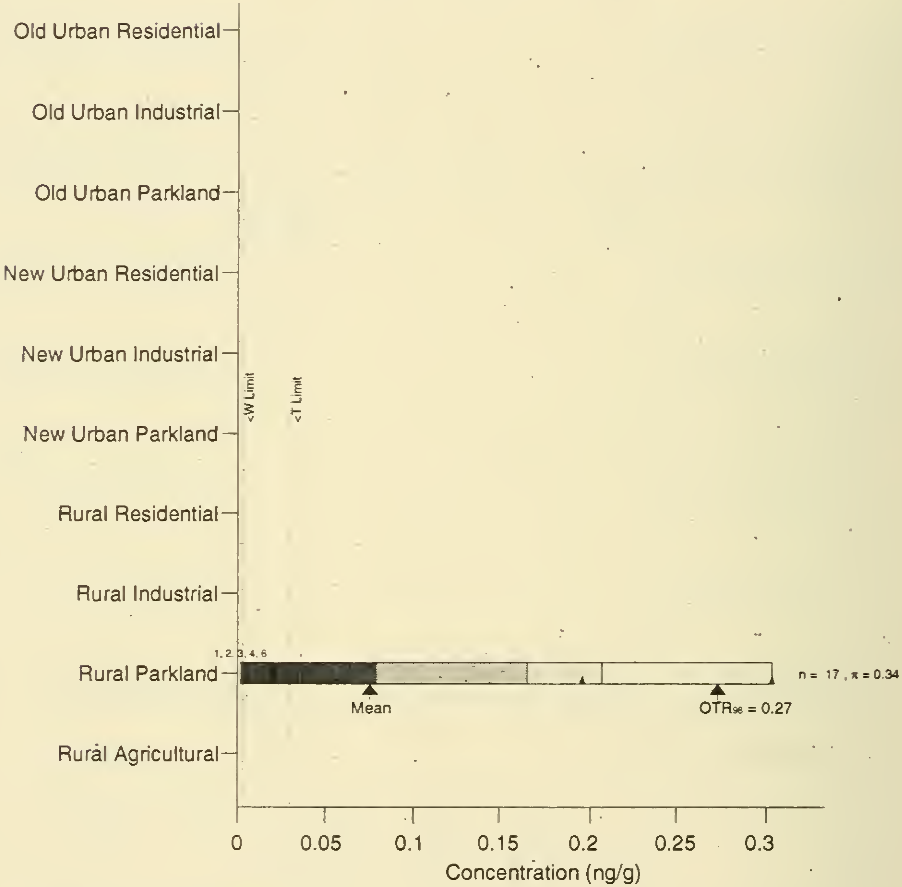
OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.91

Ontario Typical Range

Tribromomethane (Bromoform) in Class 1 Soils

(For Regions Rejected by KS Test)

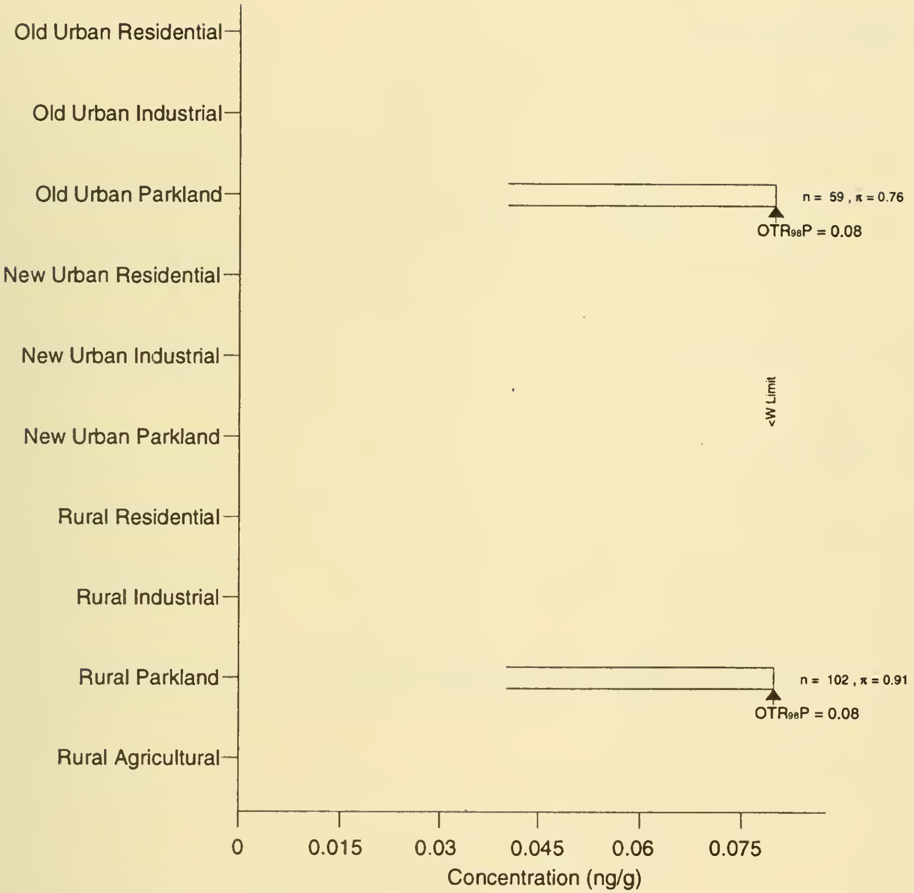


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
6. Does not include the Northwest Region

Figure 6.1.92

Ontario Typical Range

Chloromethane in Class 1 Soils

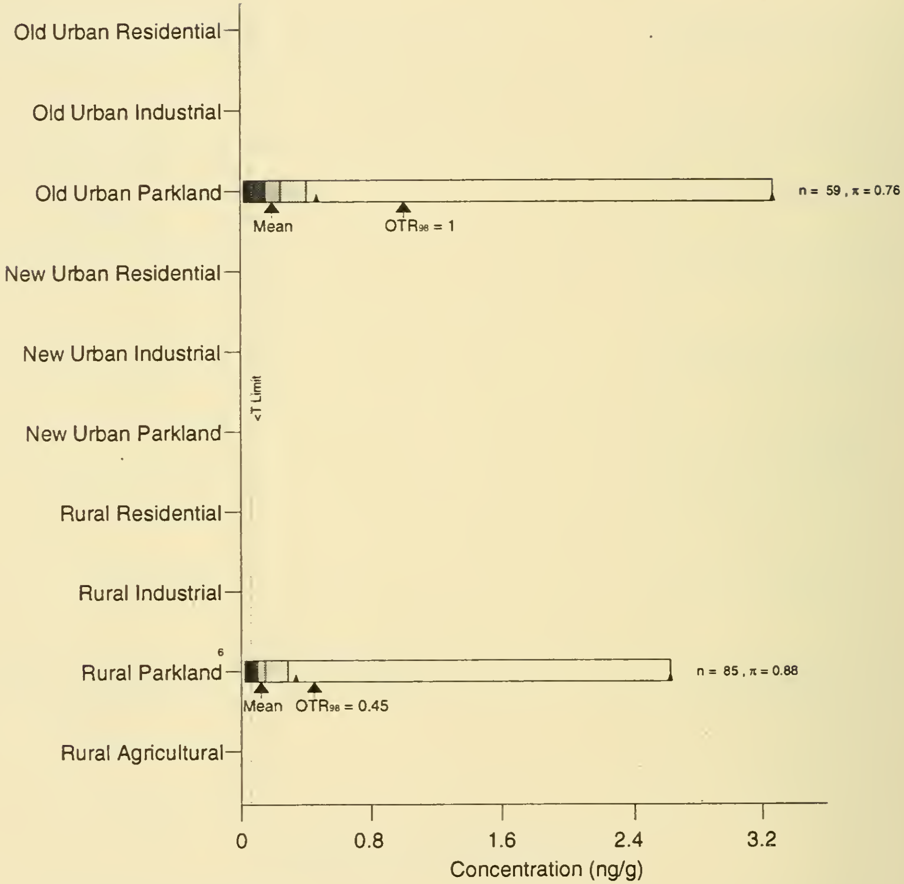


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.93

Ontario Typical Range

Dichloromethane in Class 1 Soils



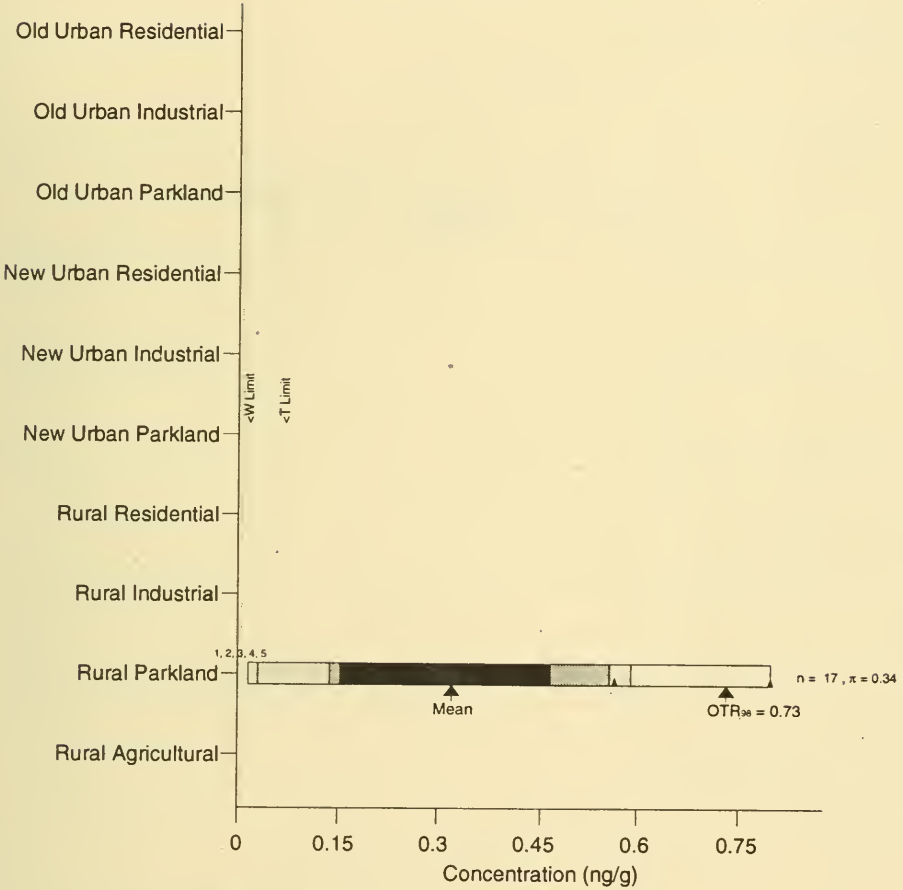
6. Does not include the Northwest Region

Figure 6.1.94

Ontario Typical Range

Dichloromethane in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.95

Ontario Typical Range

Trichloromethane (Chloroform) in Class 1 Soils

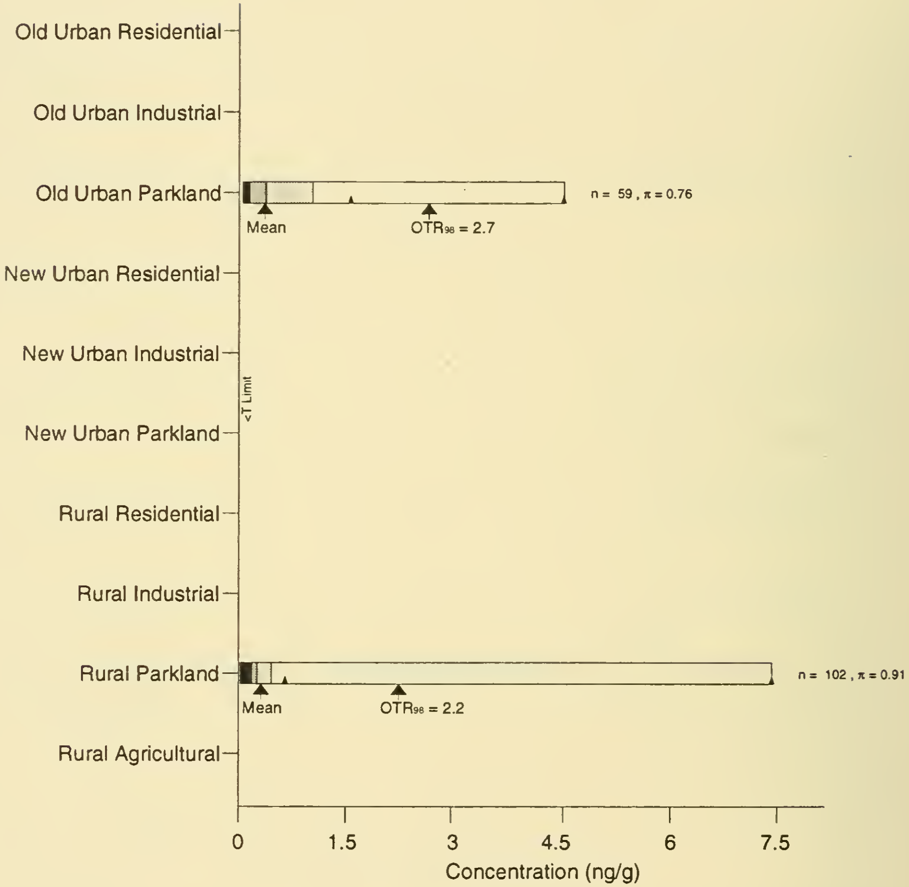
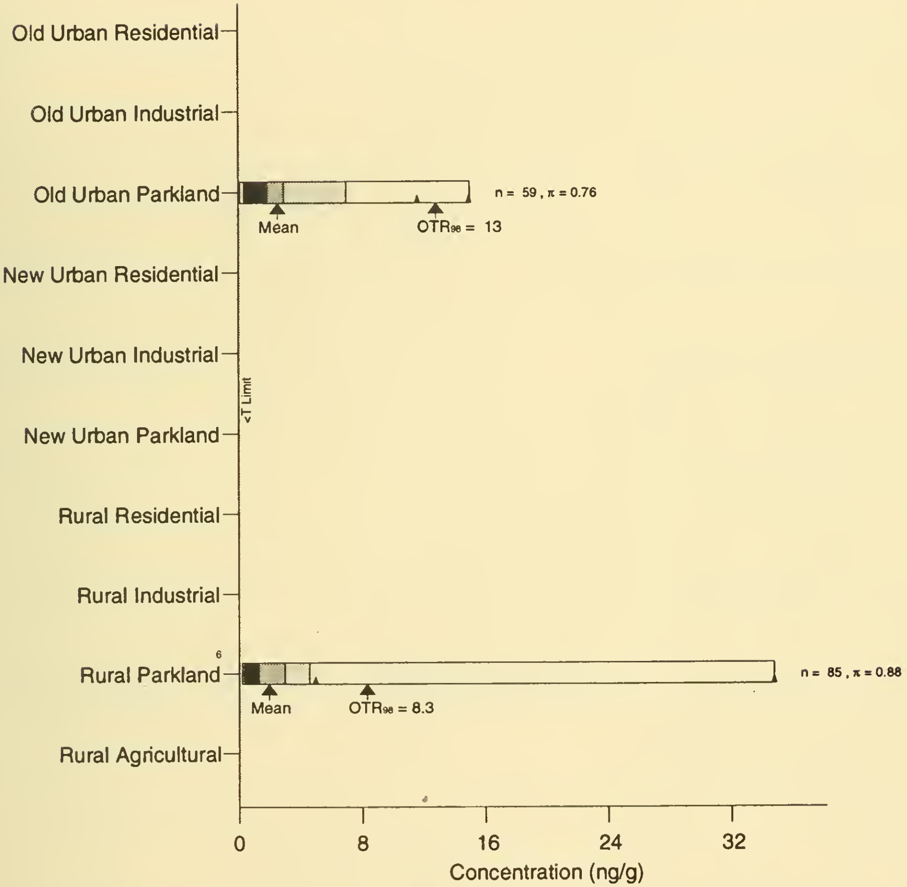


Figure 6.1.96

Ontario Typical Range

Trichlorofluoromethane in Class 1 Soils



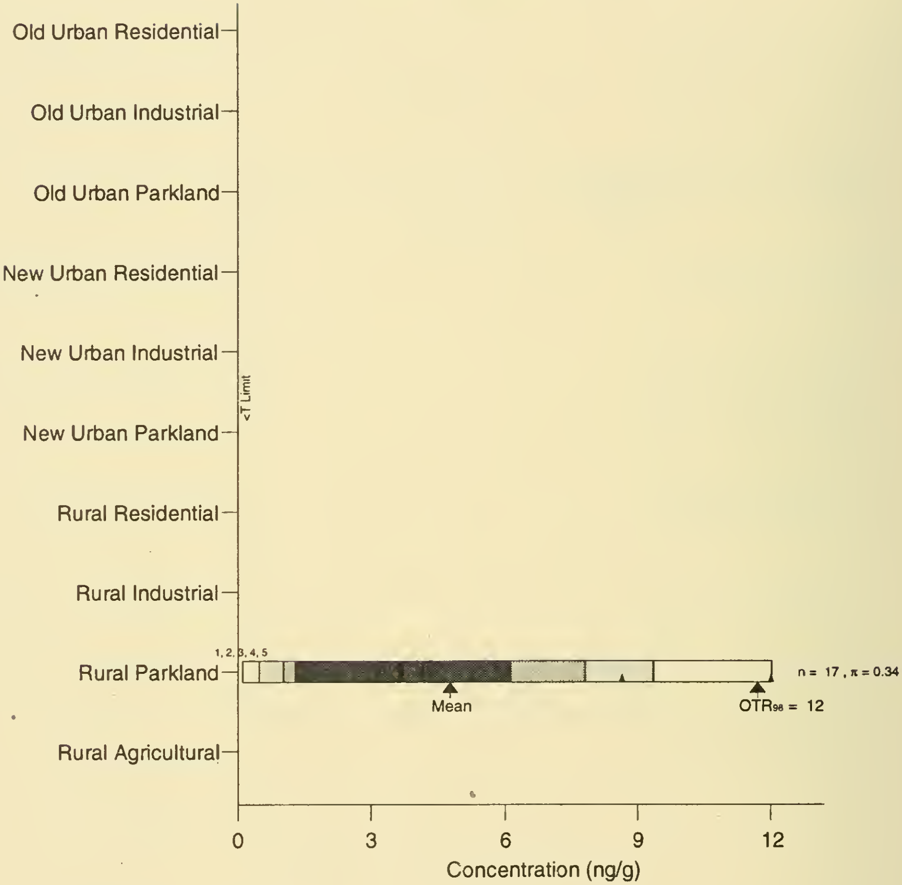
6. Does not include the Northwest Region

Figure 6.1.97

Ontario Typical Range

Trichlorofluoromethane in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.98

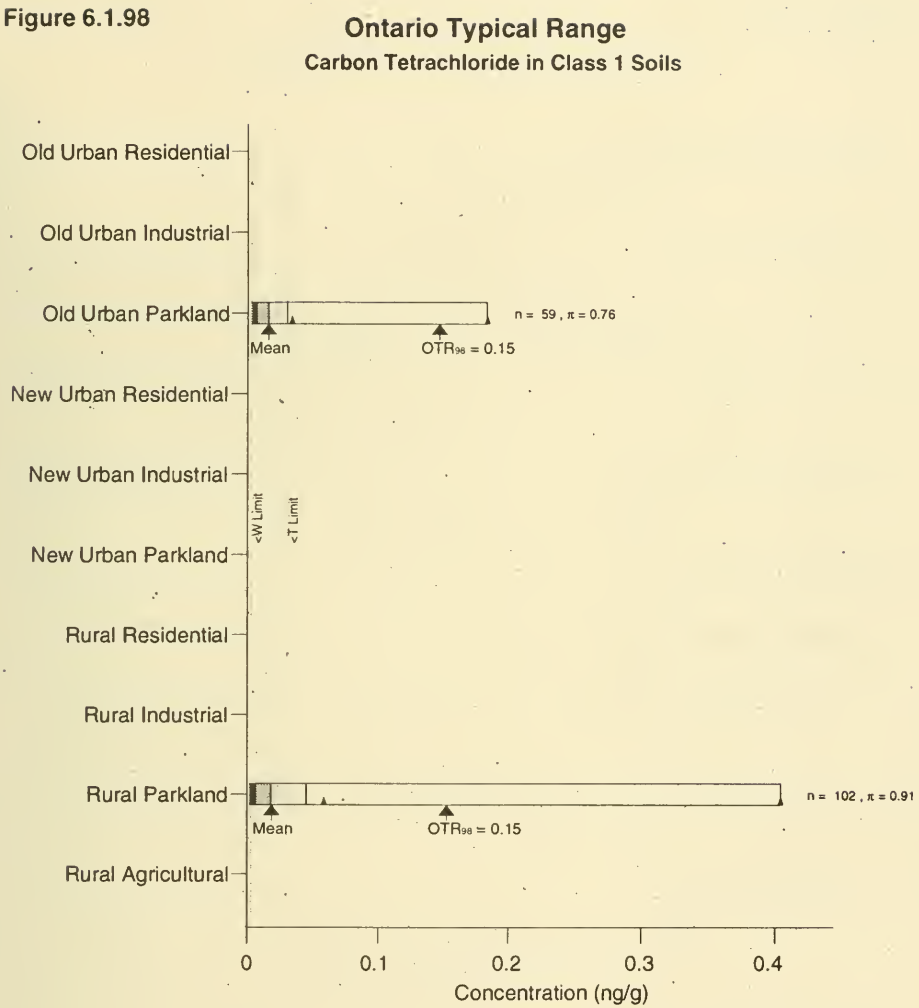
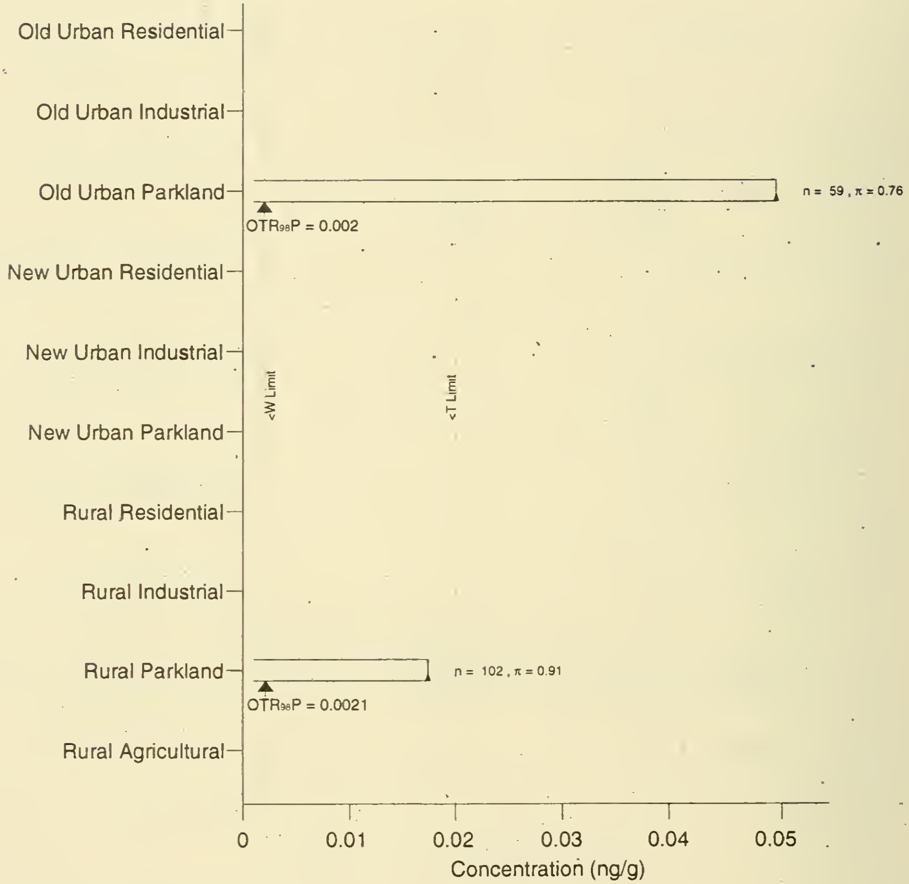

Ontario Typical Range
Carbon Tetrachloride in Class 1 Soils
Old Urban Residential
Old Urban Industrial
Old Urban Parkland
n = 59 , π = 0.76
Mean
OTR98 = 0.15
New Urban Residential
New Urban Industrial
<W Limit
<T Limit
New Urban Parkland
Rural Residential
Rural Industrial
Rural Parkland
n = 102 , π = 0.91
Mean
OTR98 = 0.15
Rural Agricultural
0
0.1
0.2
0.3
0.4
Concentration (ng/g)

Figure 6.1.99

Ontario Typical Range

1,1-Dichloroethane in Class 1 Soils



OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.100

Ontario Typical Range

1,2-Dichloroethane in Class 1 Soils

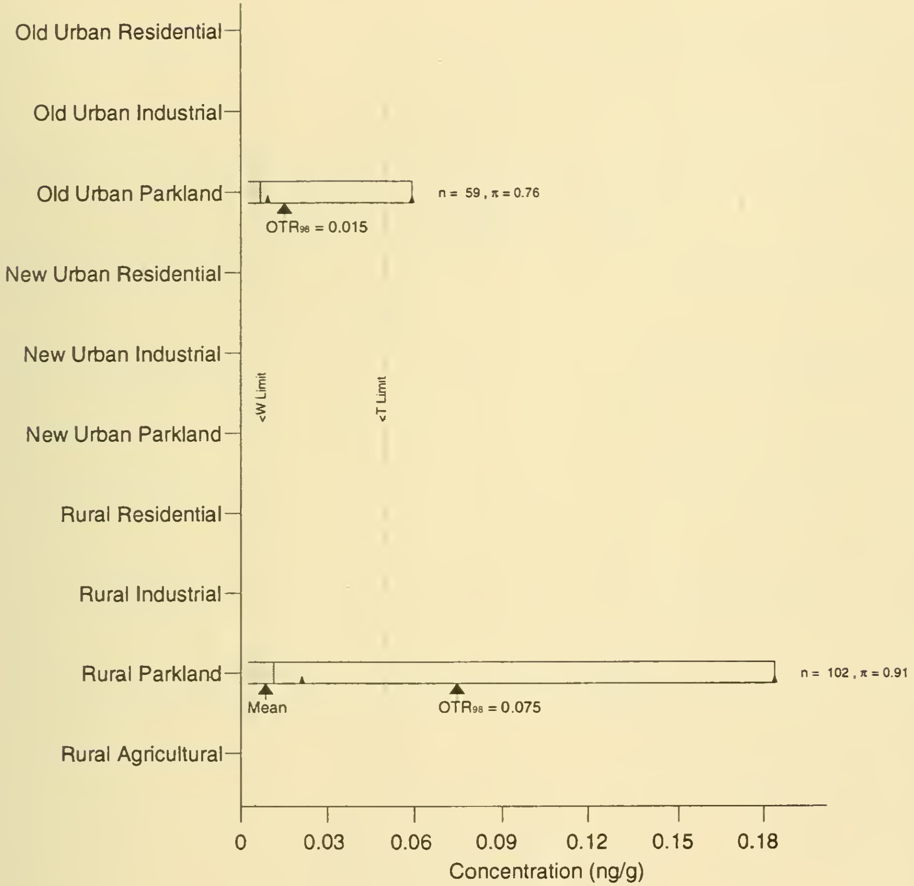


Figure 6.1.101

Ontario Typical Range

1,1,2-Trichloroethane in Class 1 Soils

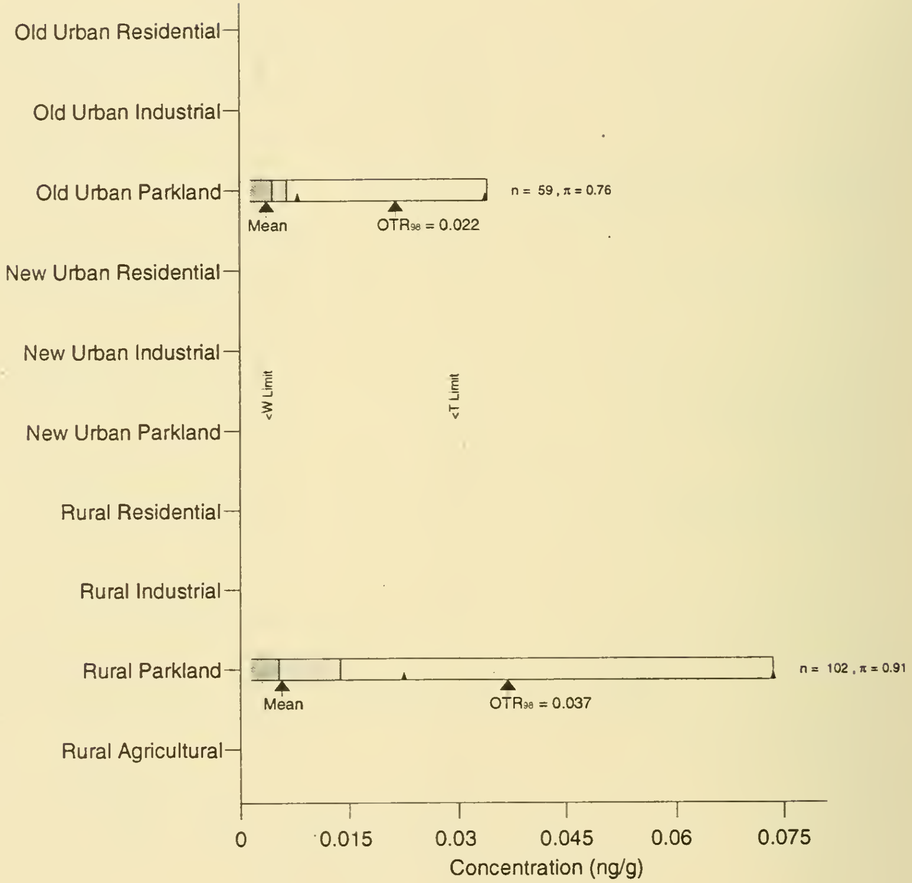
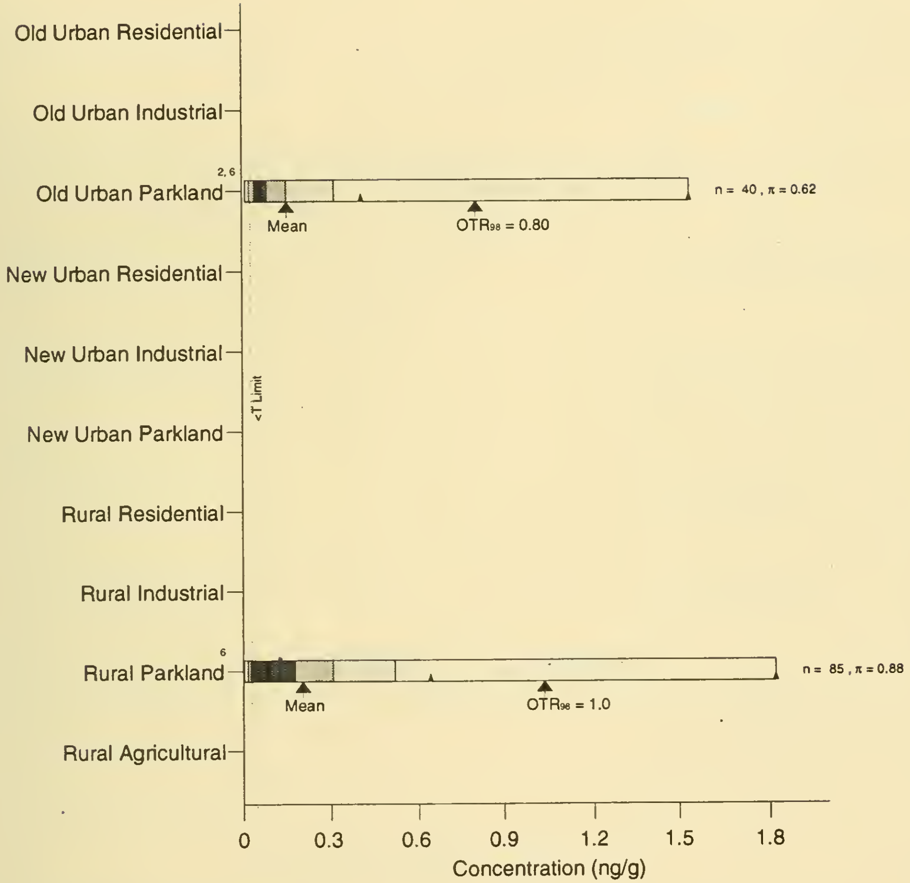


Figure 6.1.102

Ontario Typical Range

1,1,1-Trichloroethane in Class 1 Soils



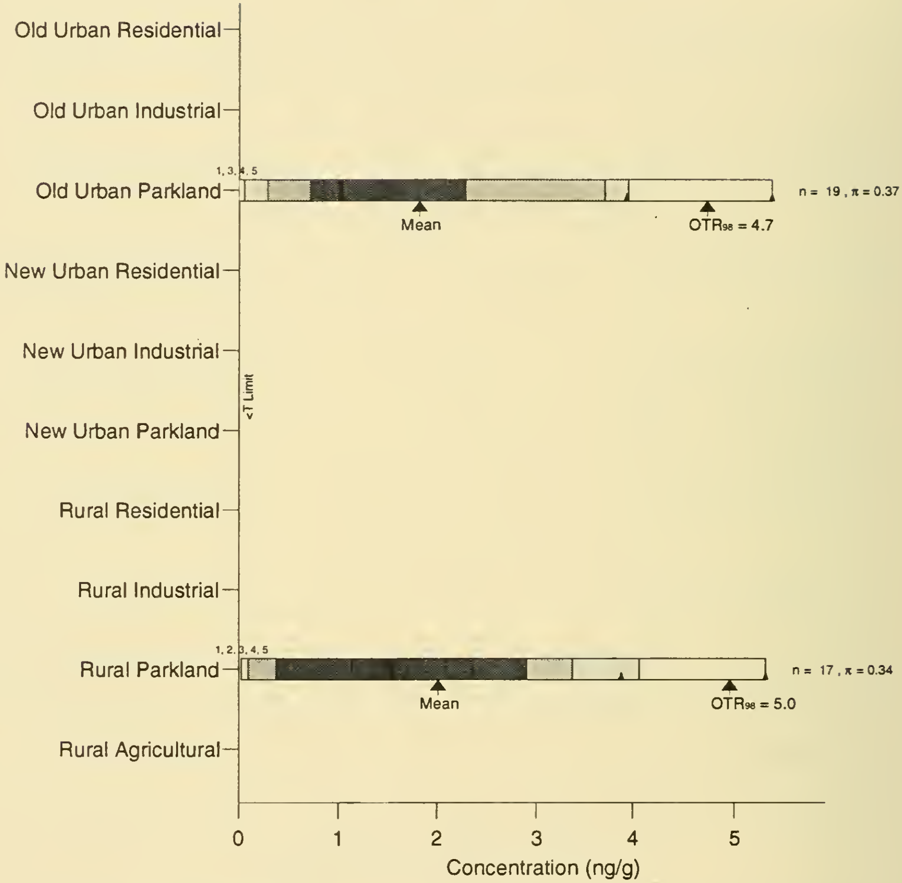
2. Does not include the WestCentral Region
6. Does not include the Northwest Region

Figure 6.1.103

Ontario Typical Range

1,1,1-Trichloroethane in Class 1 Soils

(For Regions Rejected by KS Test)

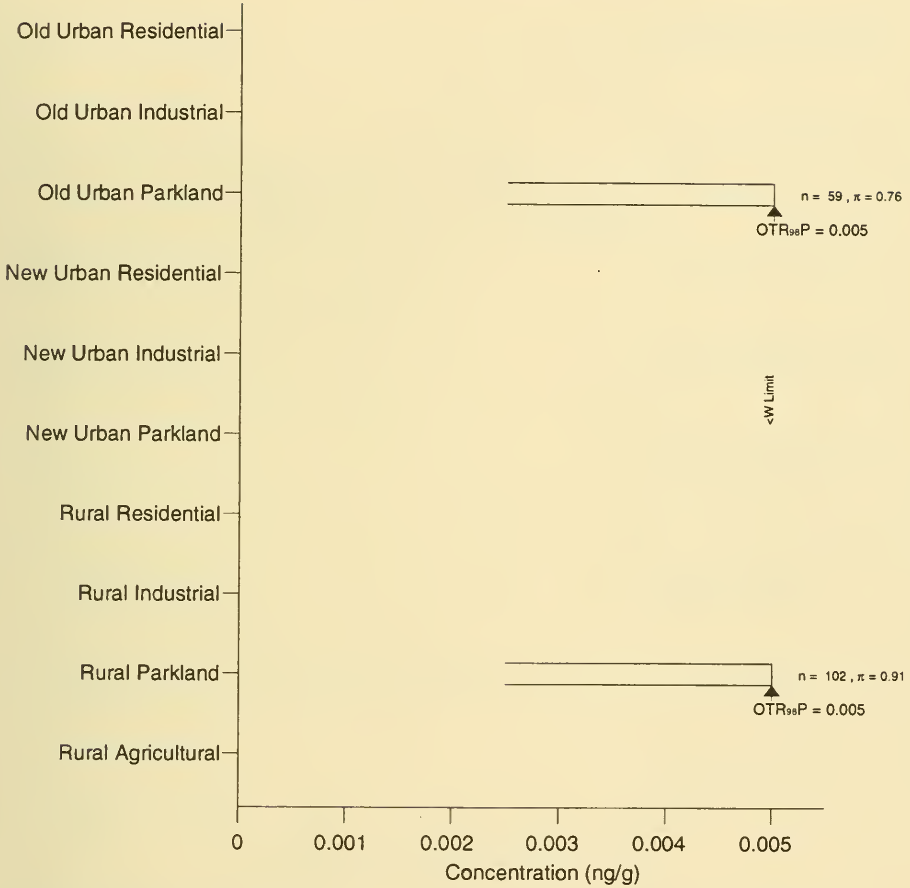


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.104

Ontario Typical Range

1,1,2,2-Tetrachloroethane in Class 1 Soils

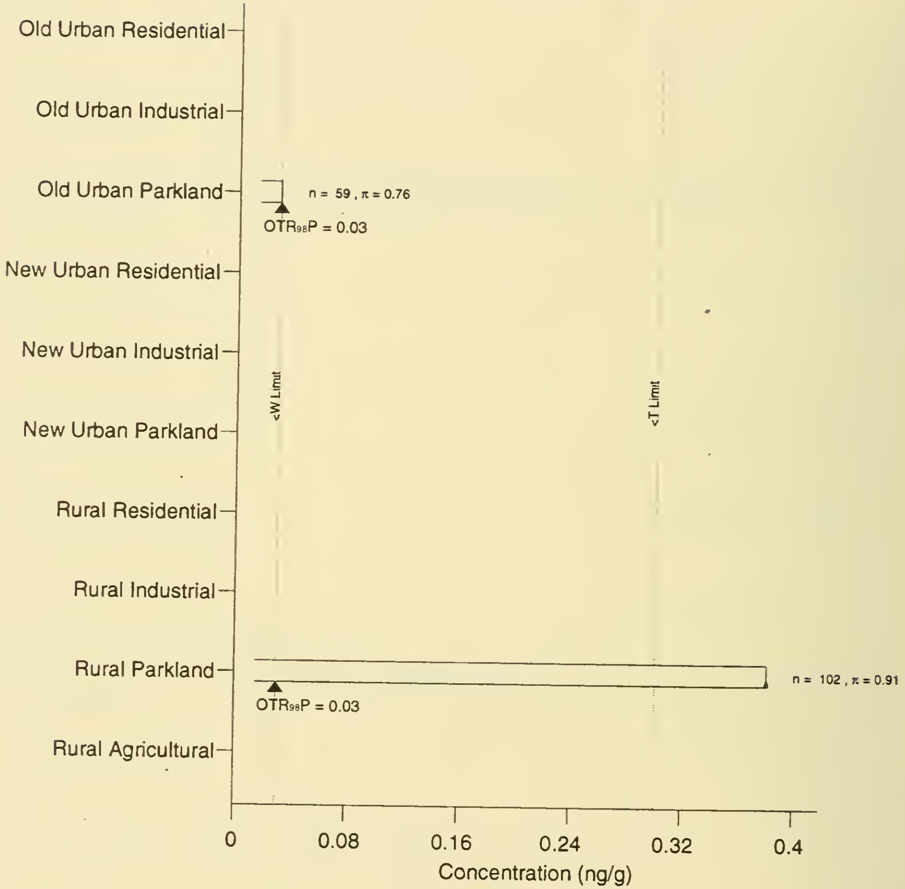


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.105

Ontario Typical Range

Chloroethylene (vinylchloride) in Class 1 Soils

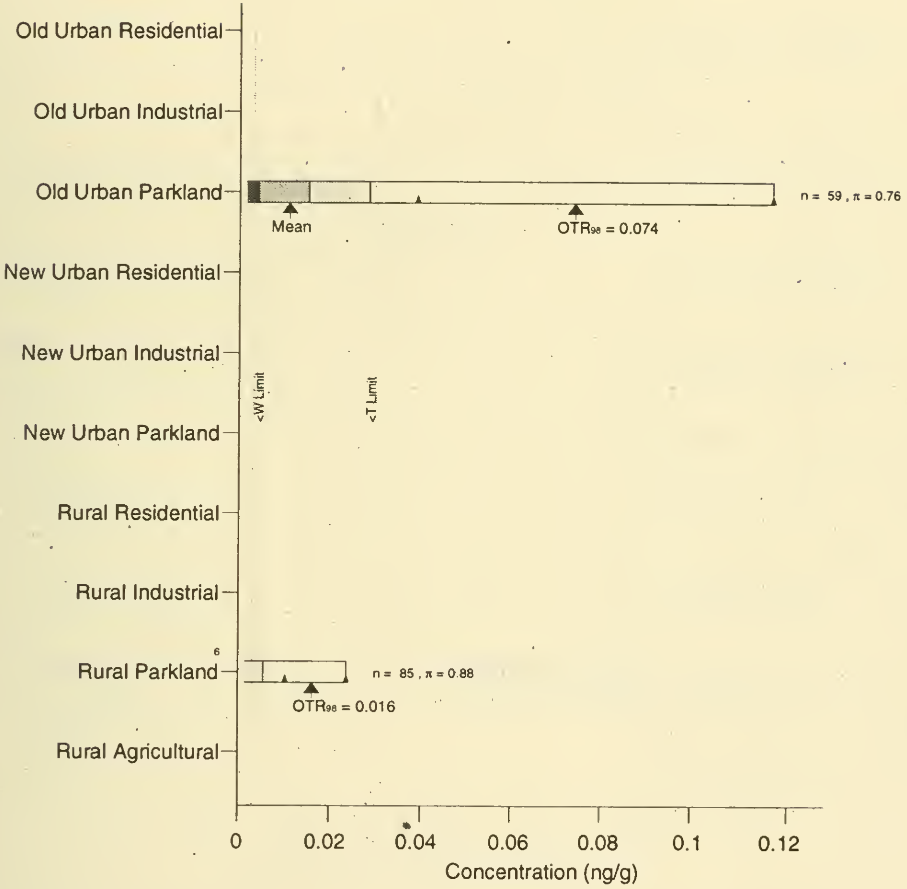


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.106

Ontario Typical Range

1,1-Dichloroethylene in Class 1 Soils



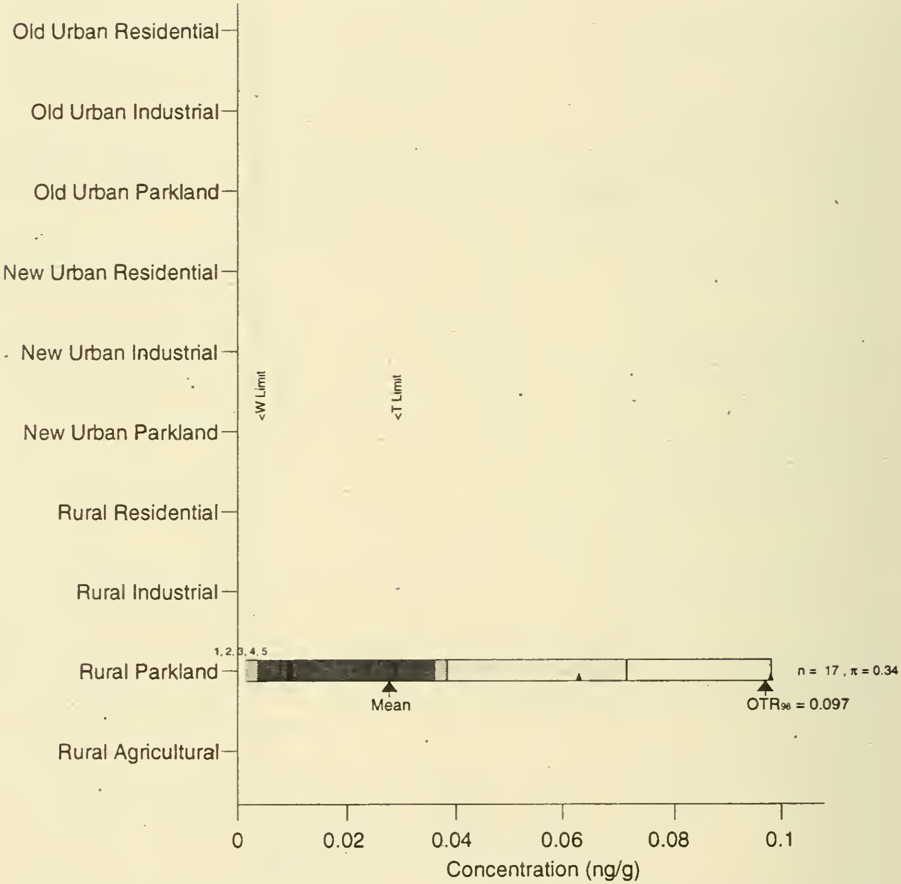
6. Does not include the Northwest Region

Figure 6.1.107

Ontario Typical Range

1,1-Dichloroethylene in Class 1 Soils

(For Regions Rejected by KS Test)

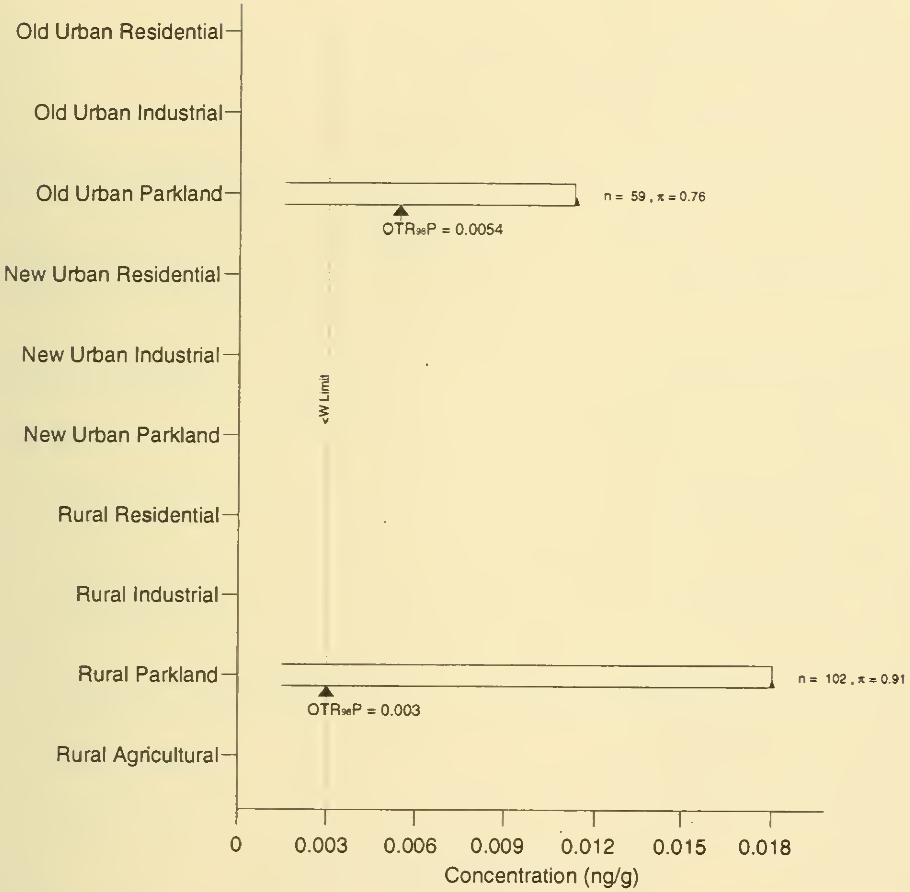


1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
5. Does not include the Northeast Region

Figure 6.1.108

Ontario Typical Range

trans-1,2-Dichloroethylene in Class 1 Soils

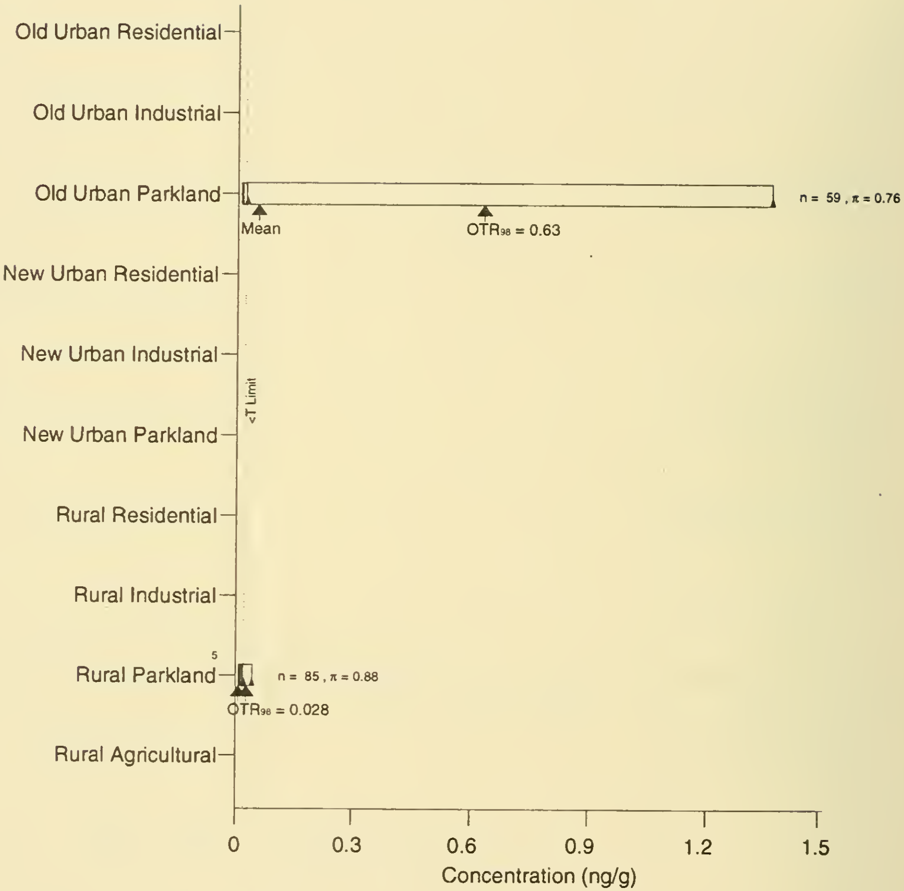


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.109

Ontario Typical Range

Trichloroethylene in Class 1 Soils



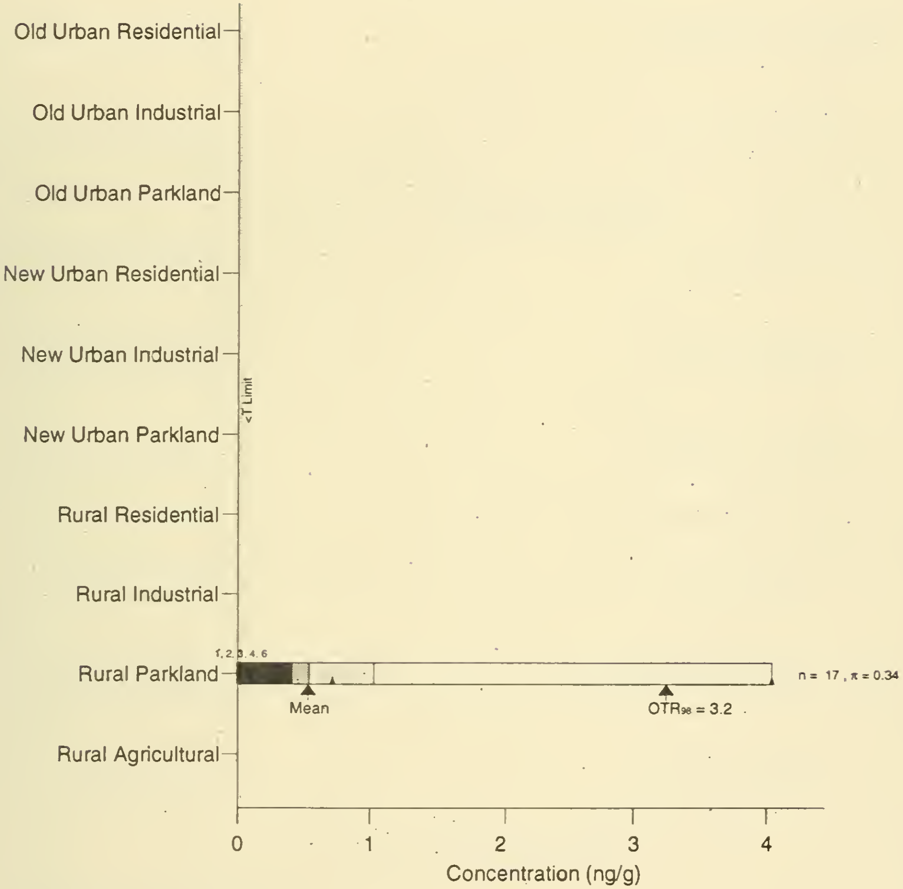
5. Does not include the Northeast Region

Figure 6.1.110

Ontario Typical Range

Trichloroethylene in Class 1 Soils

(For Regions Rejected by KS Test)



1. Does not include the Southwest Region
2. Does not include the WestCentral Region
3. Does not include the Central Region
4. Does not include the Southeast Region
6. Does not include the Northwest Region

Figure 6.1.111

Ontario Typical Range

Tetrachloroethylene in Class 1 Soils

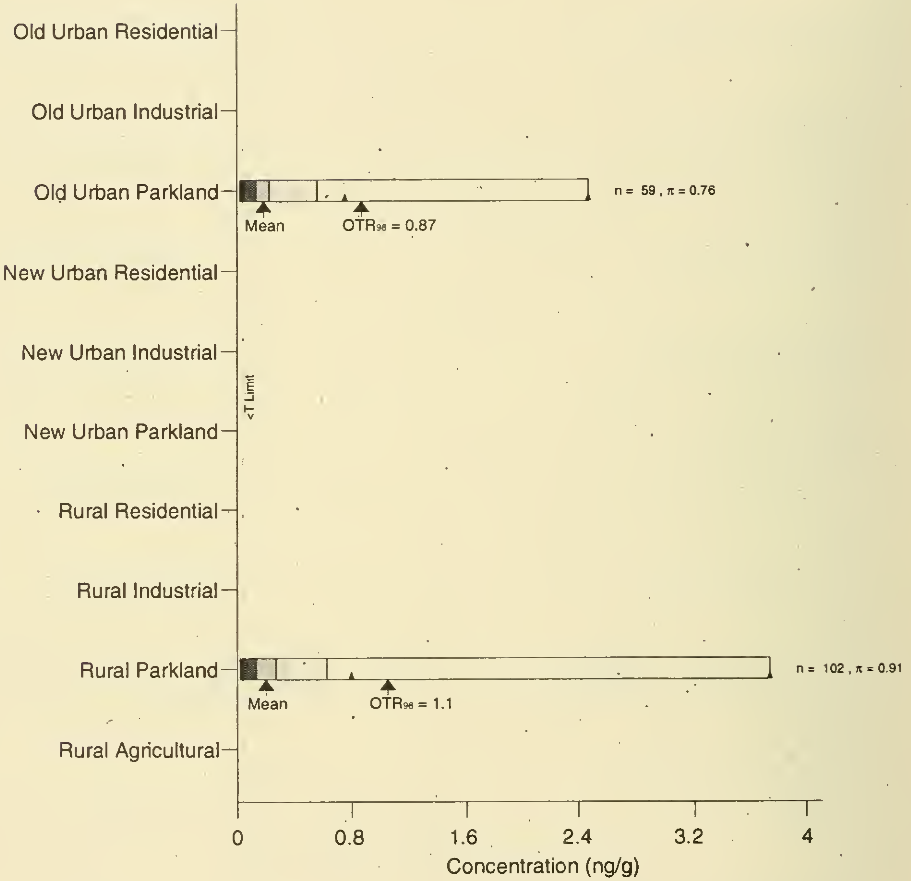
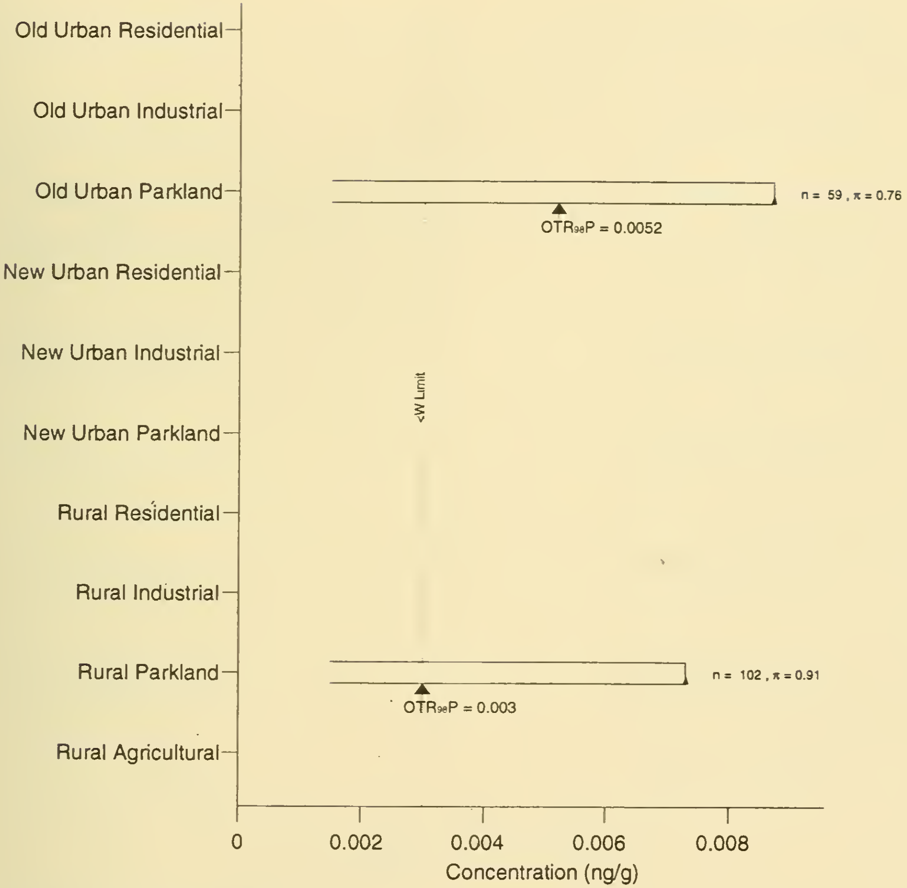


Figure 6.1.112

Ontario Typical Range

1,2-Dichloropropane in Class 1 Soils

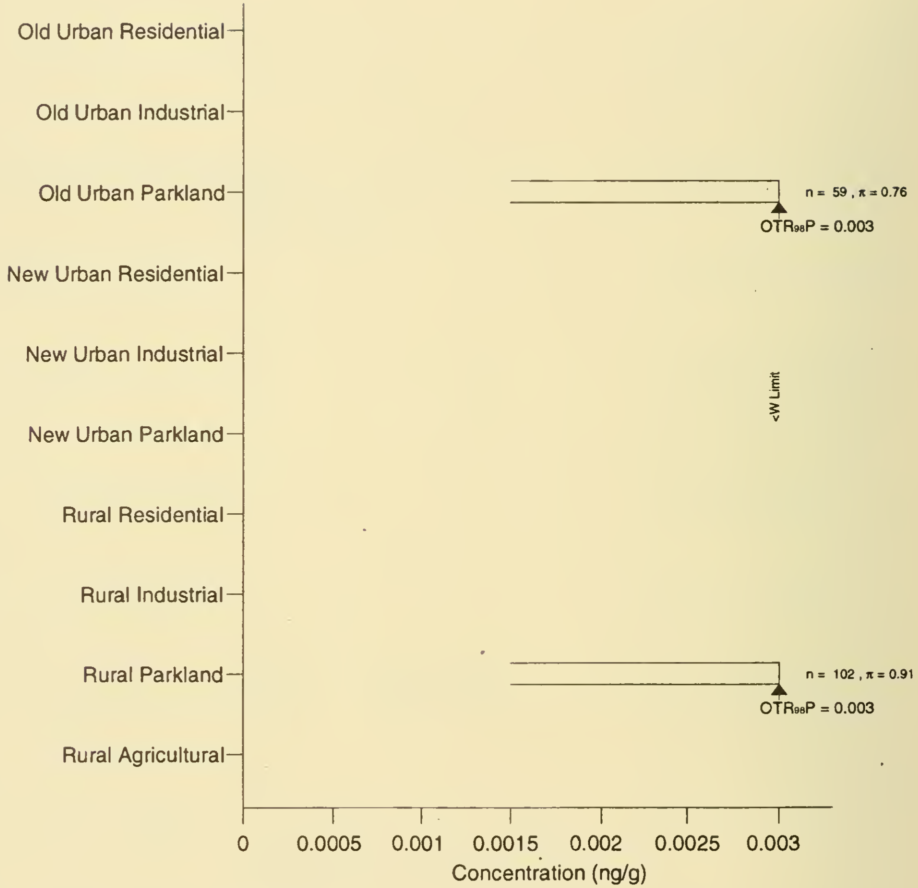


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.113

Ontario Typical Range

cis-1,3 Dichloropropene in Class 1 Soils

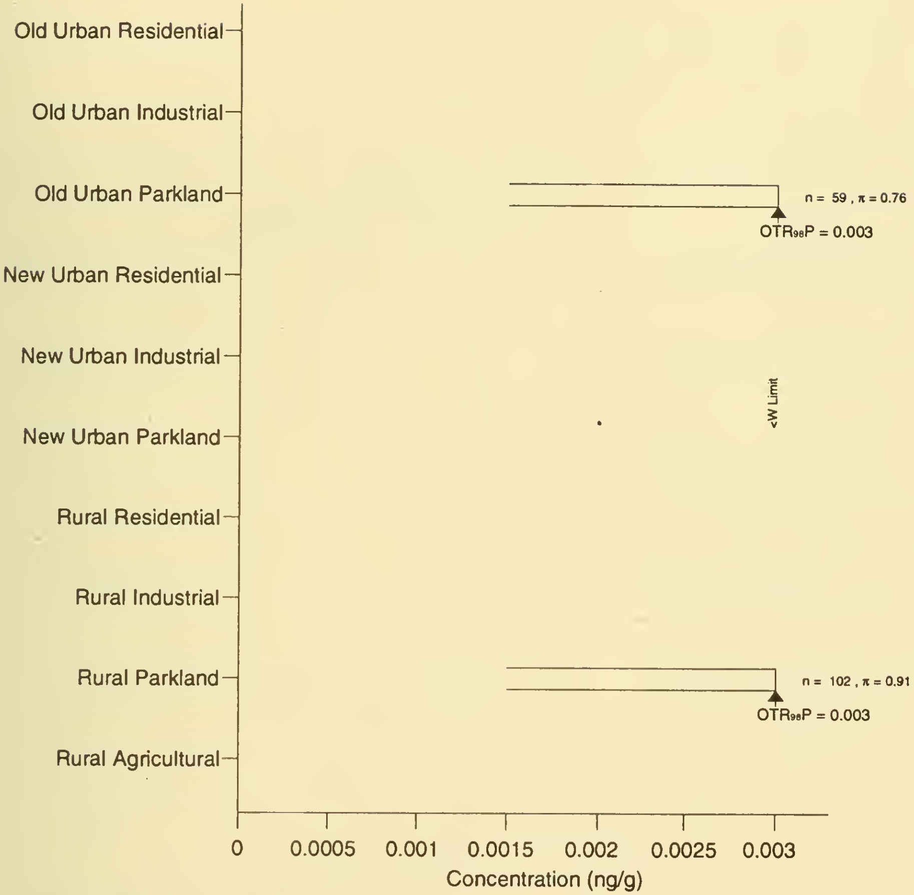


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.114

Ontario Typical Range

trans-1,3 Dichloropropene in Class 1 Soils

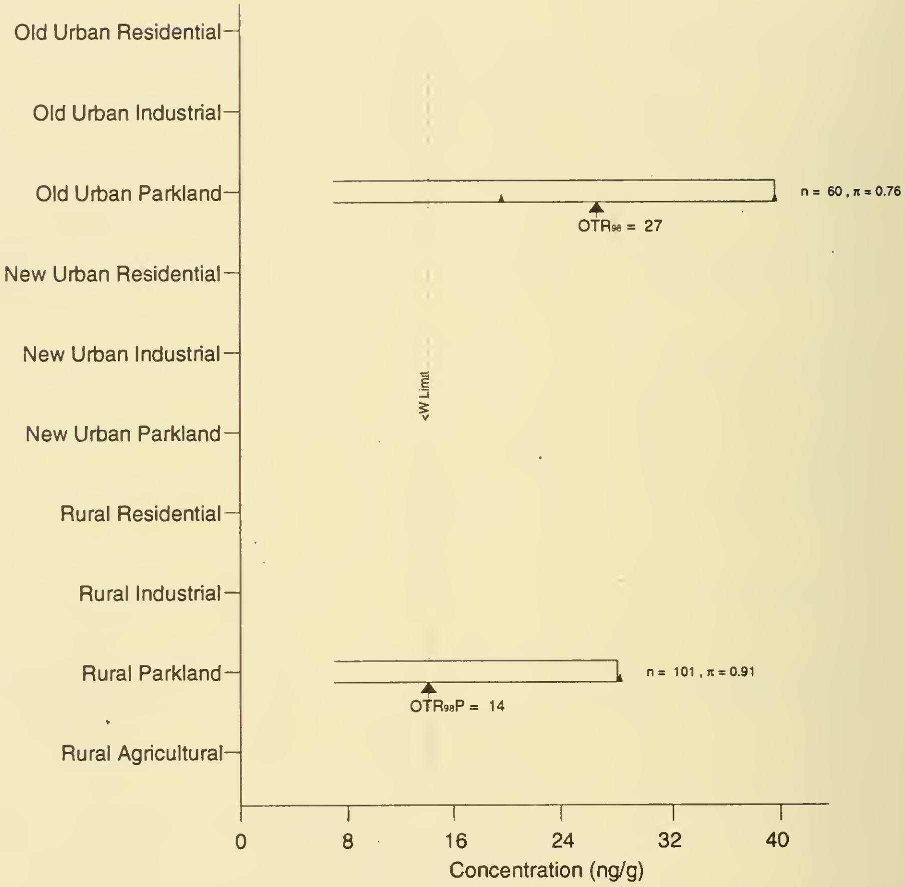


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.115

Ontario Typical Range

Phenol in Class 1 Soils

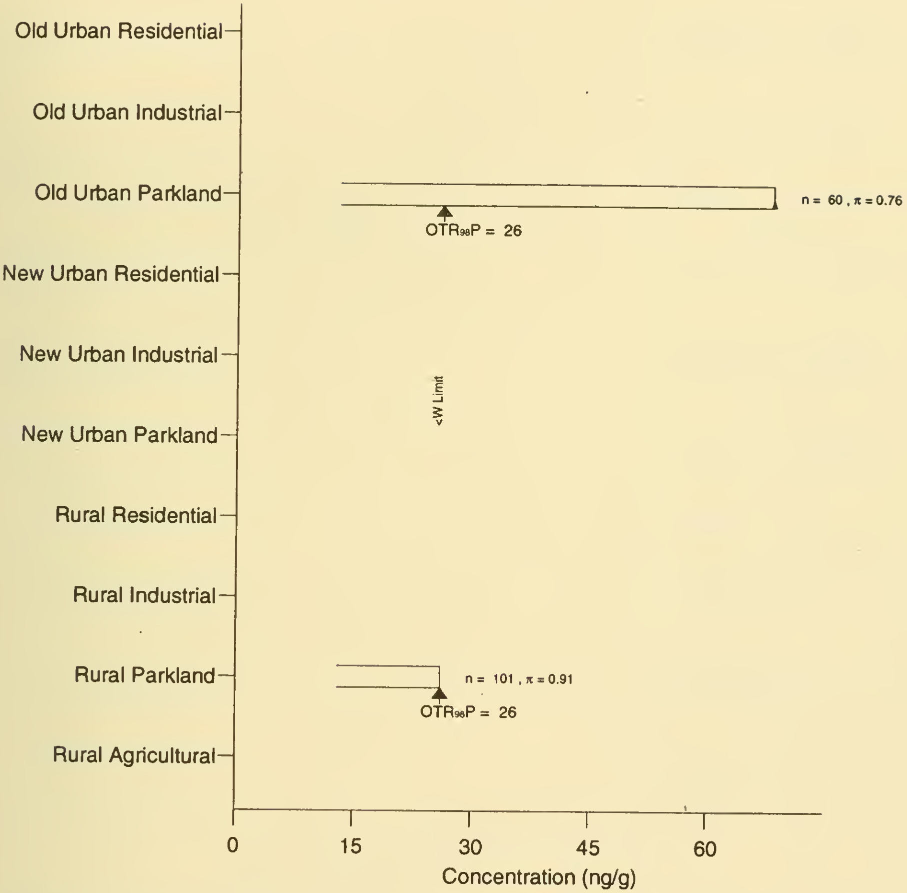


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.116

Ontario Typical Range

m-Cresol in Class 1 Soils

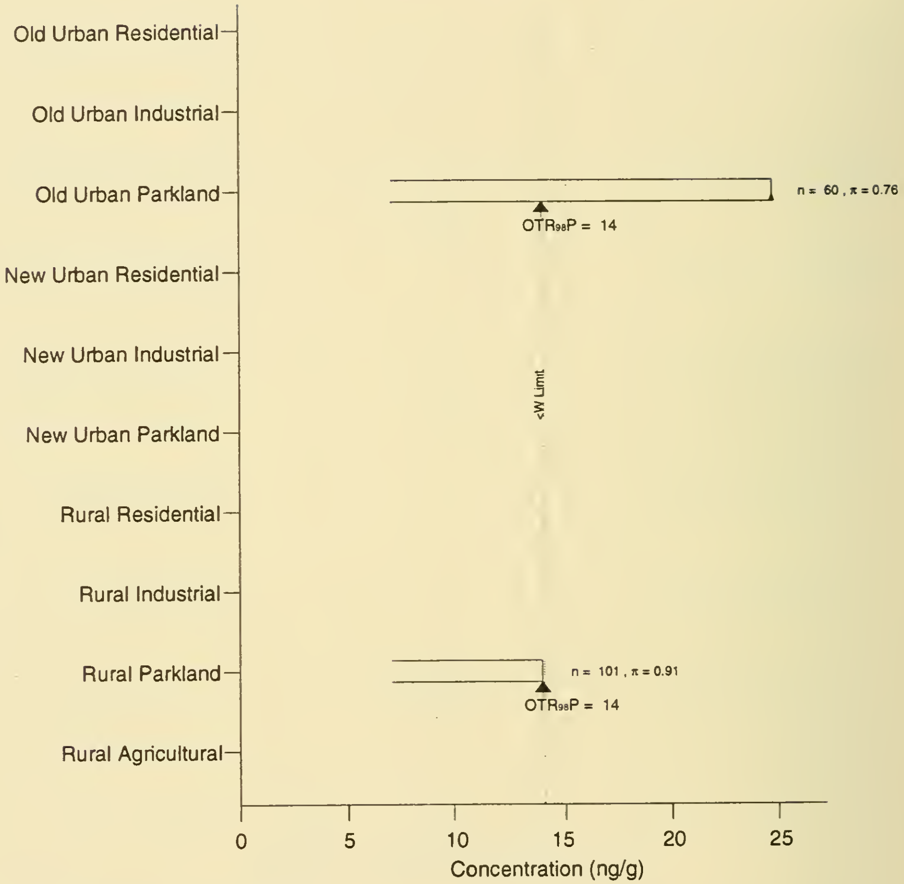


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.117

Ontario Typical Range

o-Cresol in Class 1 Soils

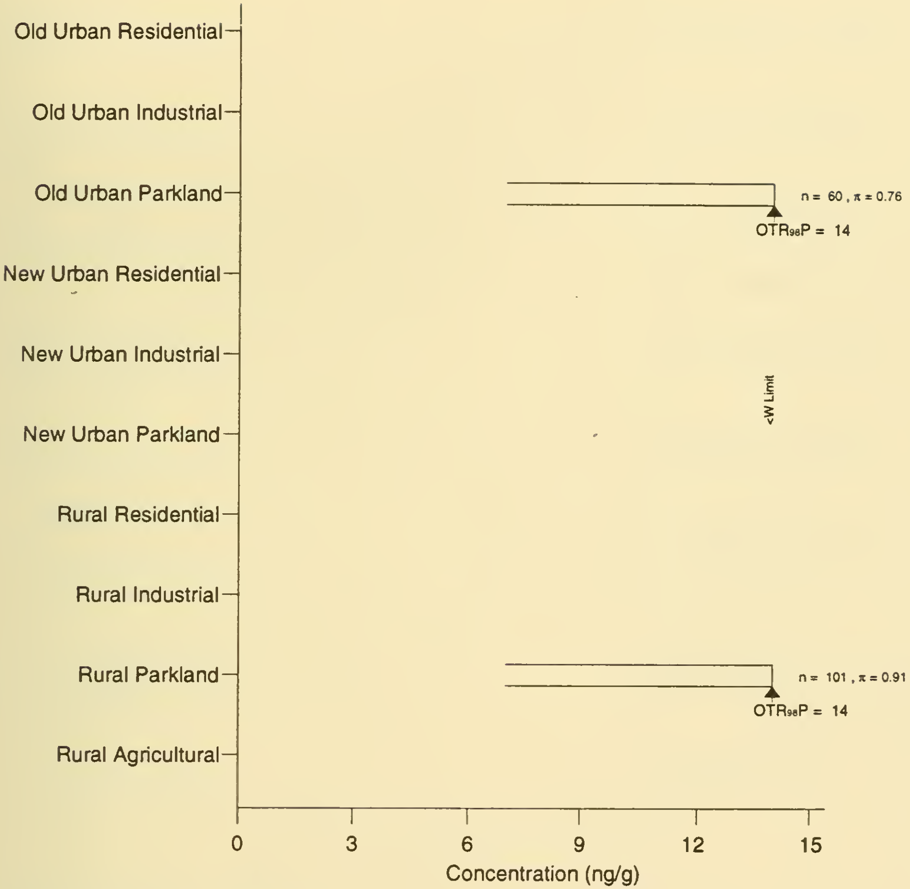


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.118

Ontario Typical Range

p-Cresol in Class 1 Soils

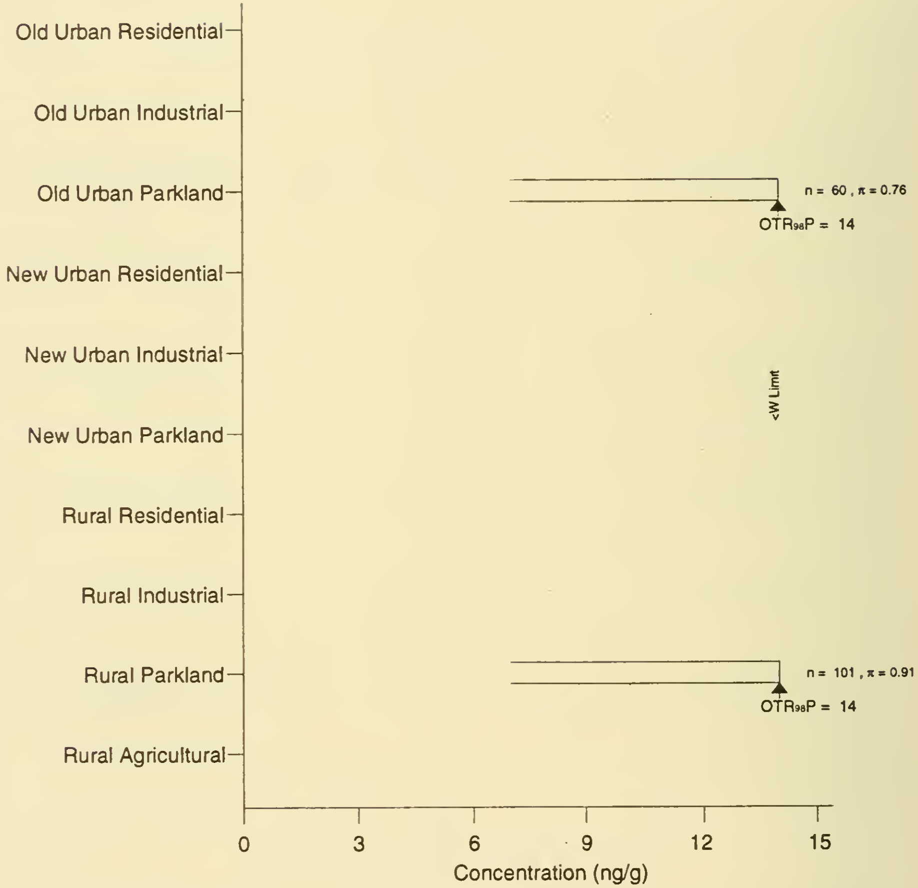


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.119

Ontario Typical Range

4,6-Dinitro-o-cresol in Class 1 Soils

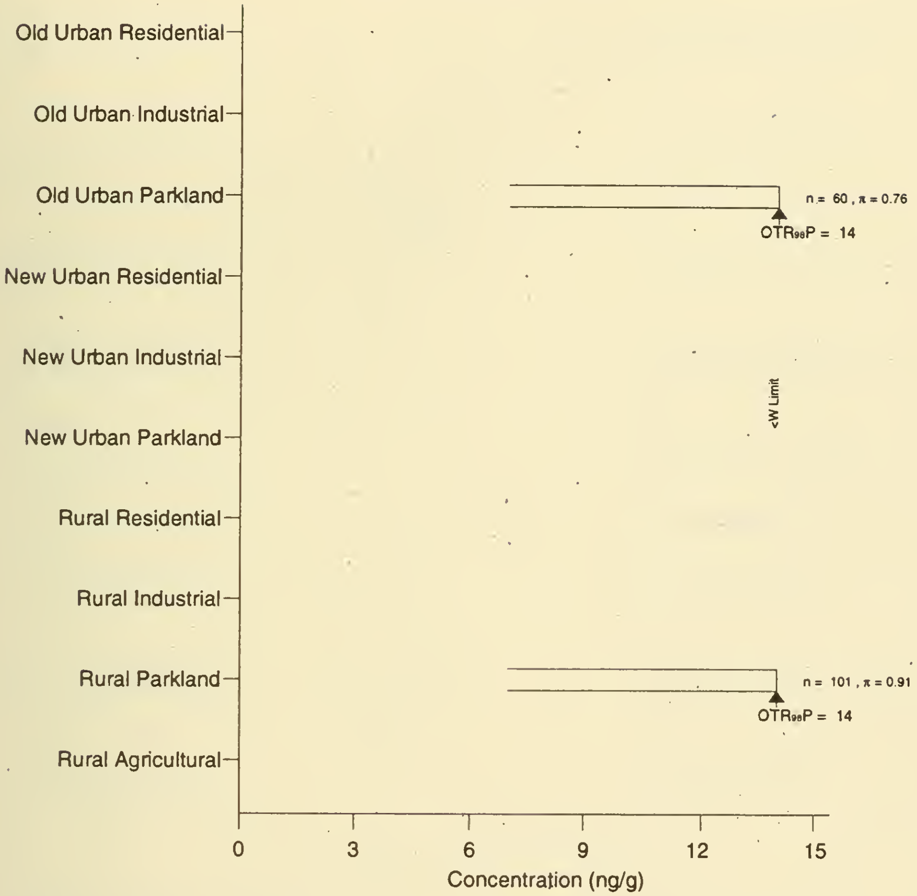


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.120

Ontario Typical Range

2-Chlorophenol in Class 1 Soils

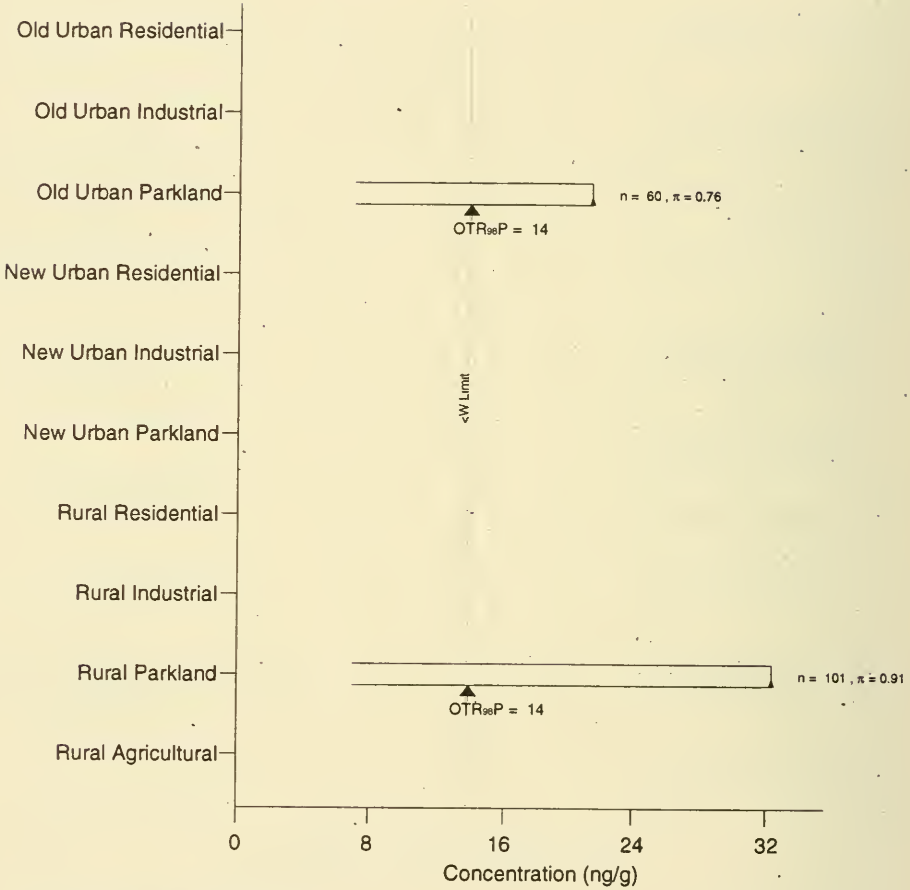


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.121

Ontario Typical Range

2,4-Dichlorophenol in Class 1 Soils

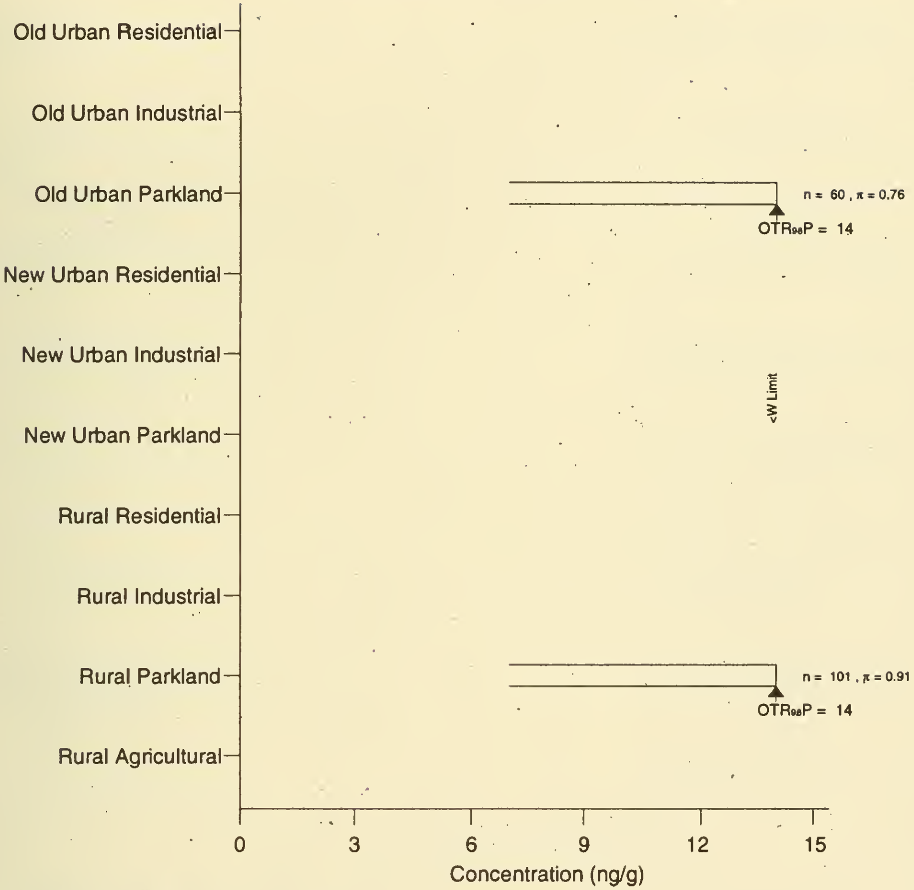


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.122

Ontario Typical Range

2,6-Dichlorophenol in Class 1 Soils

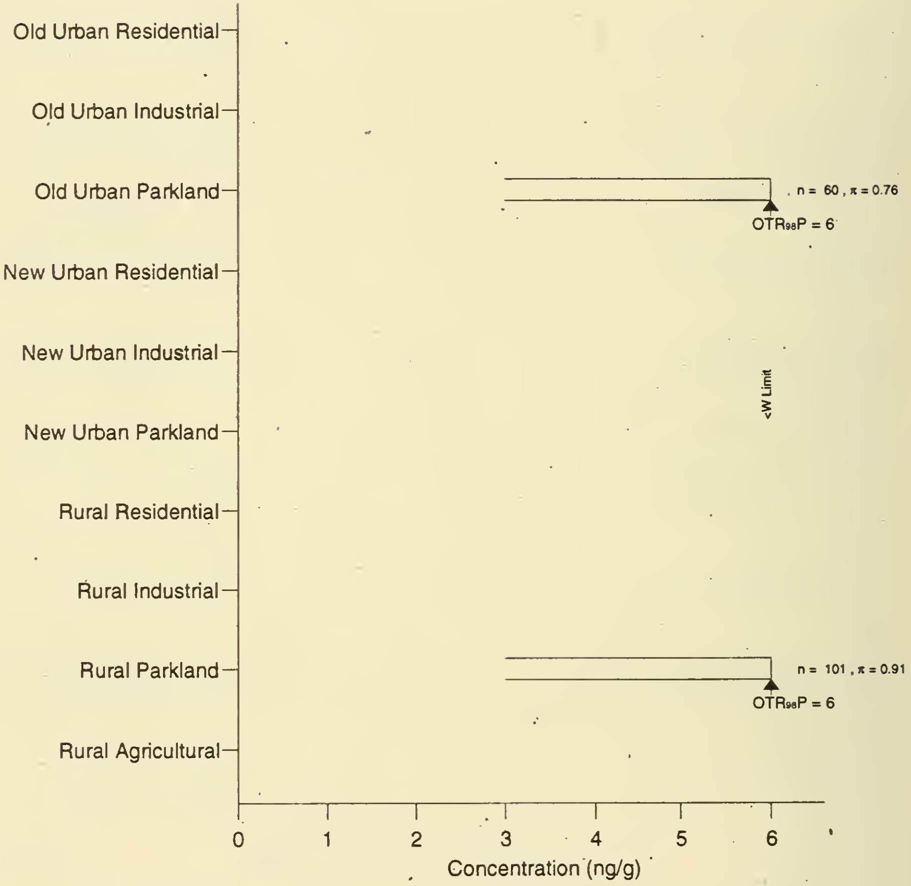


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.123

Ontario Typical Range

2,3,4-Trichlorophenol in Class 1 Soils

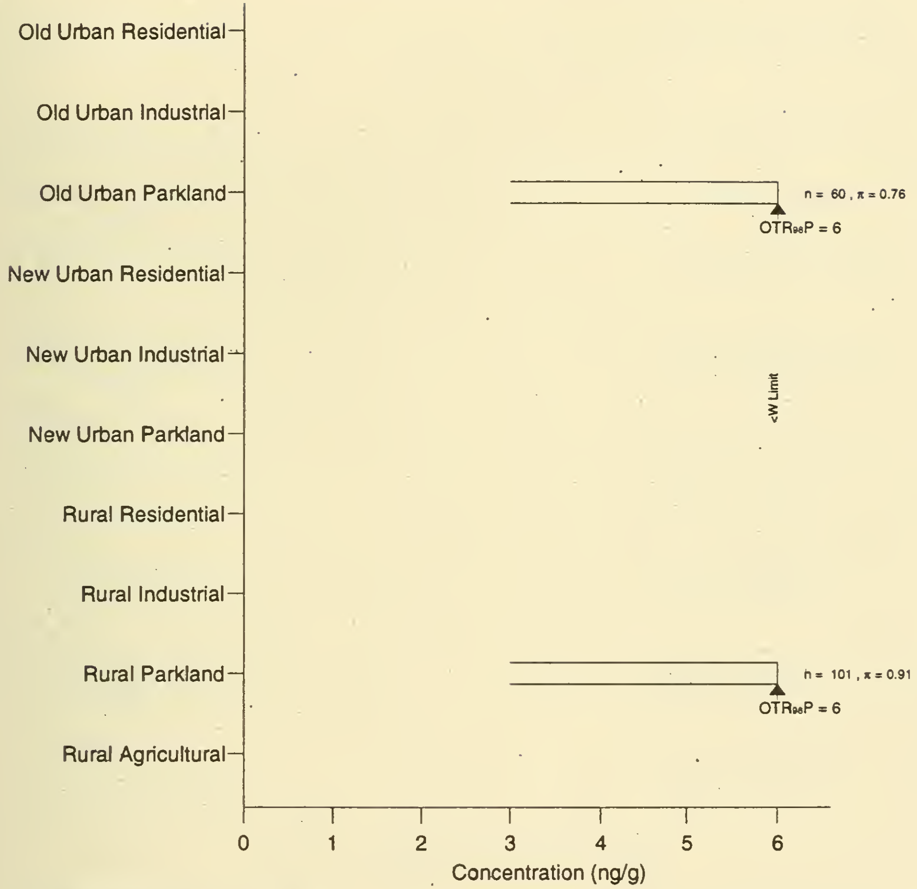


$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

Figure 6.1.124

Ontario Typical Range

2,3,5-Trichlorophenol in Class 1 Soils

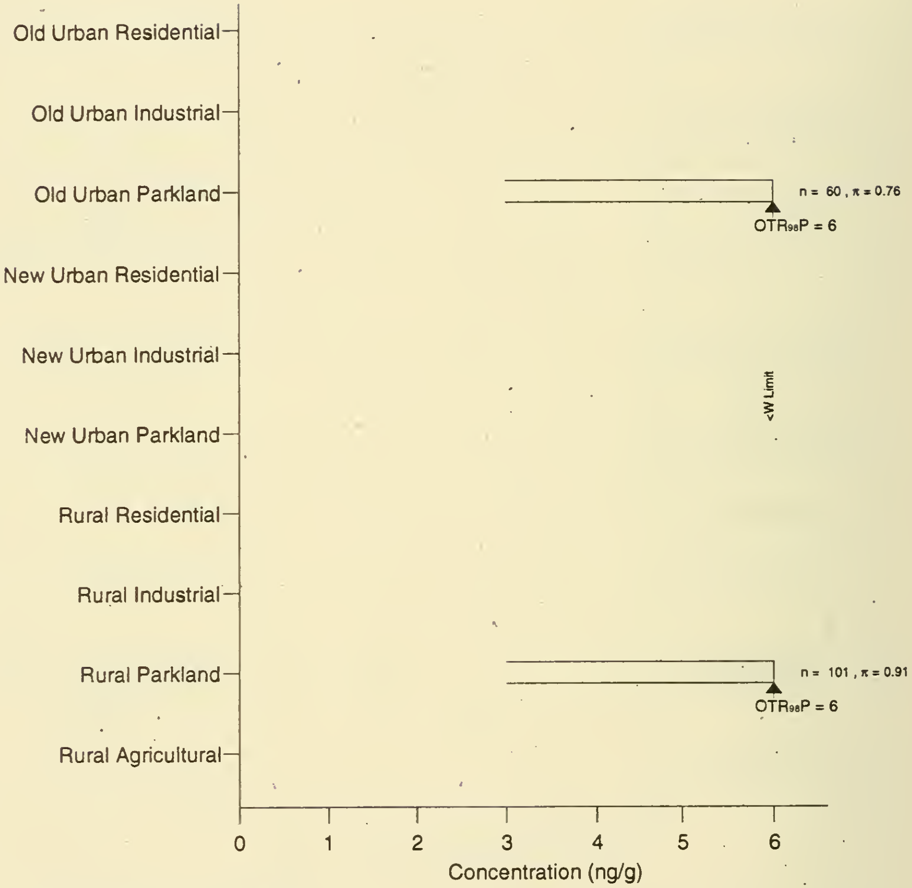


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.125

Ontario Typical Range

2,4,5-Trichlorophenol in Class 1 Soils

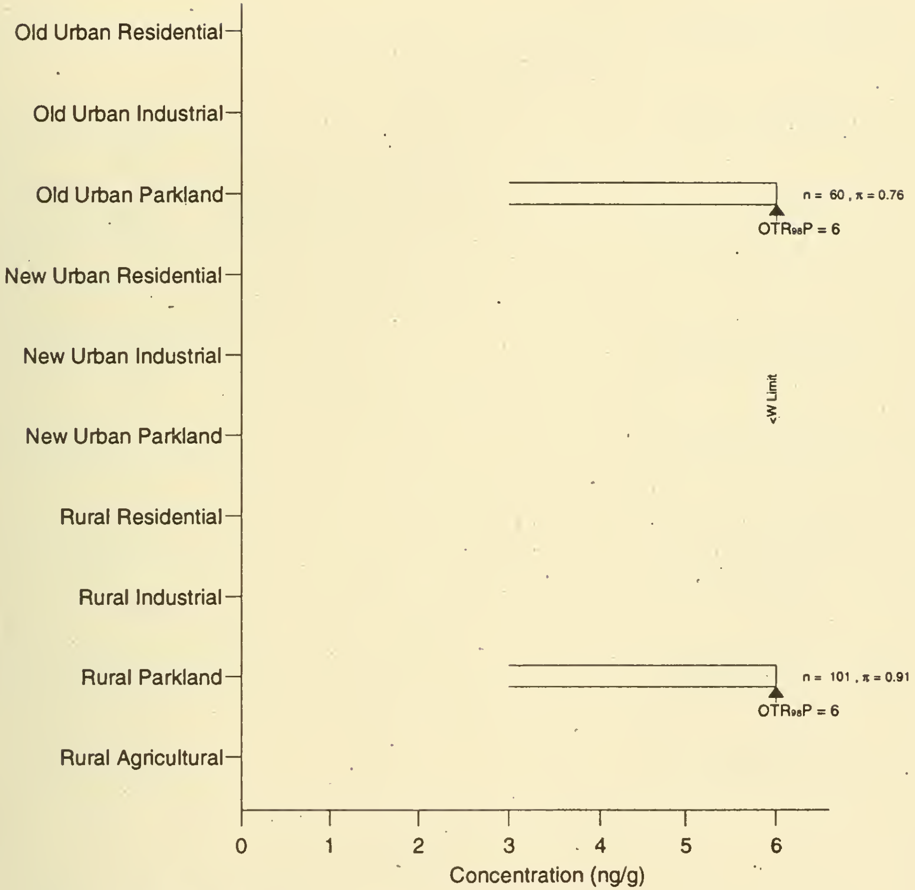


$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

Figure 6.1.126

Ontario Typical Range

2,4,6-Trichlorophenol in Class 1 Soils

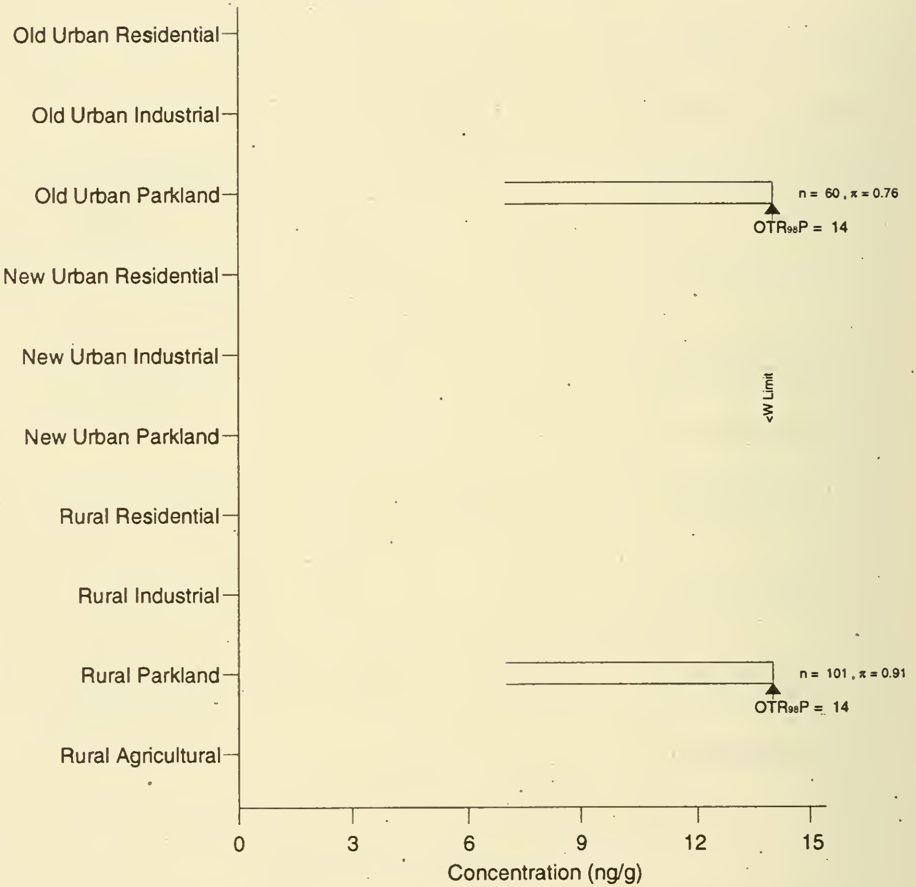


$\mathrm{OTR_{98}P}$ - Provisional $\mathrm{OTR_{98}}$, insufficient data >W

Figure 6.1.127

Ontario Typical Range

2,3,4,5-Tetrachlorophenol in Class 1 Soils

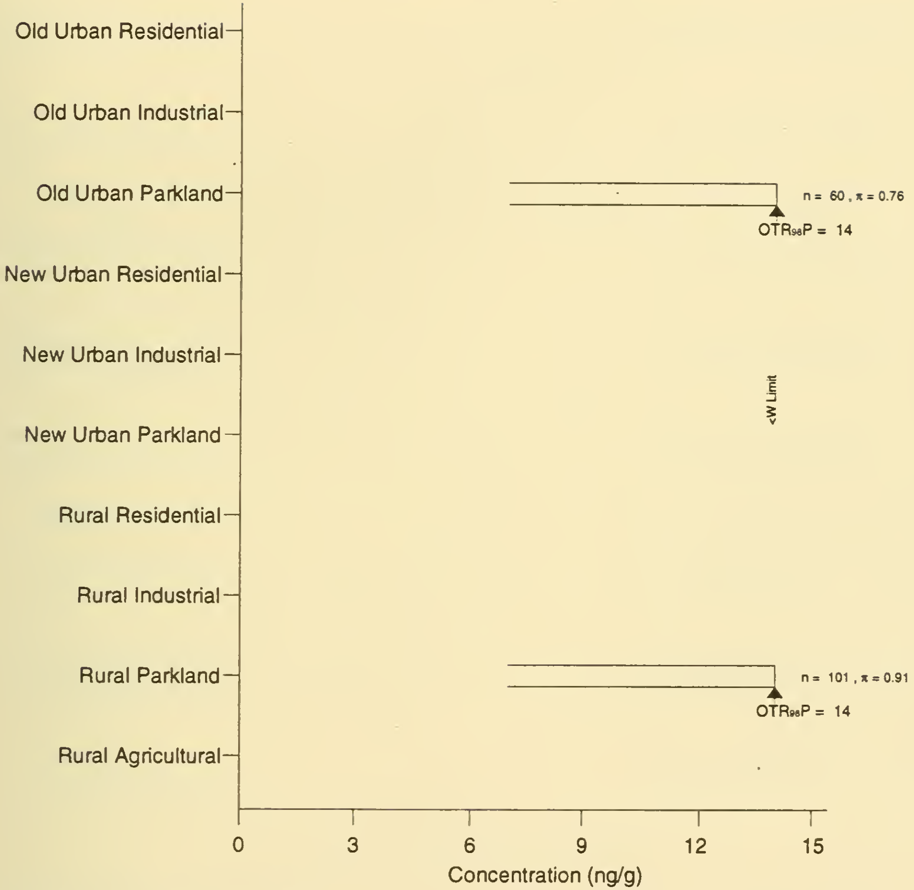


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.128

Ontario Typical Range

2,3,4,6-Tetrachlorophenol in Class 1 Soils

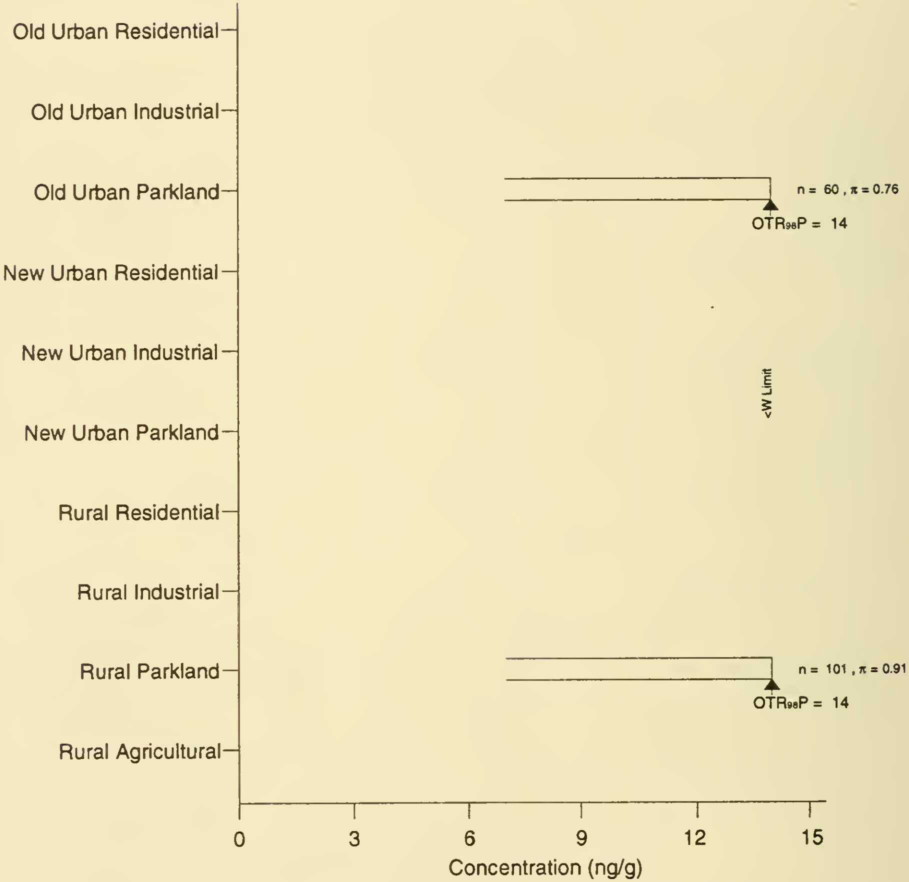


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.129

Ontario Typical Range

2,3,5,6-Tetrachlorophenol in Class 1 Soils

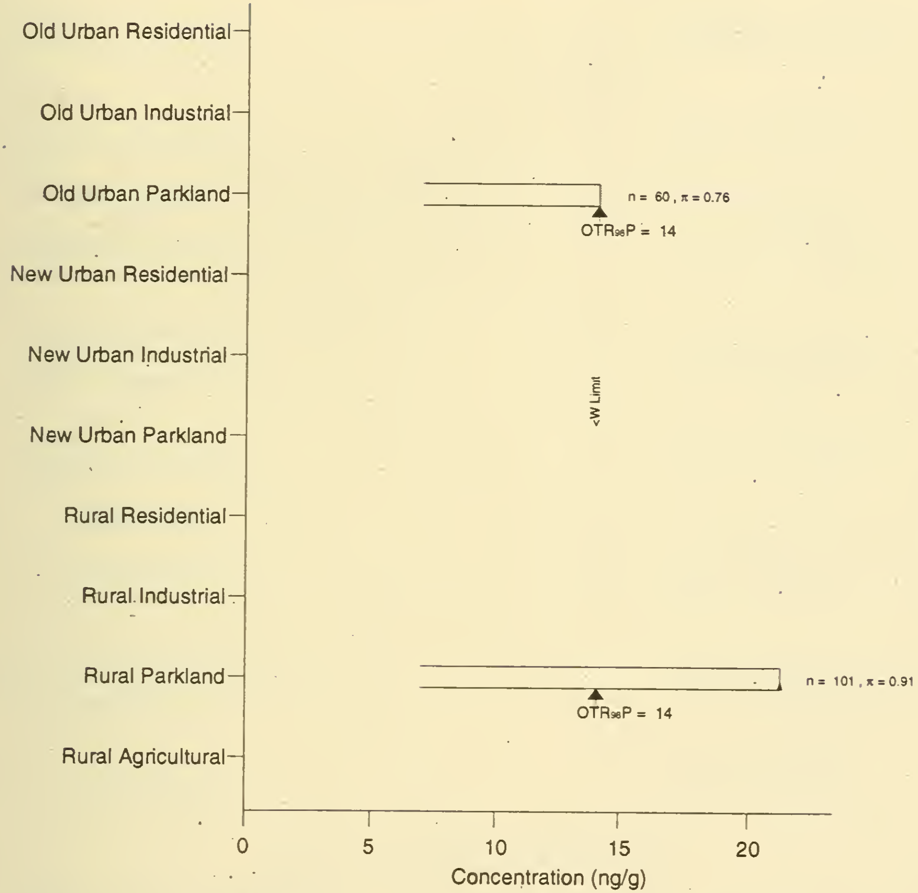


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.130

Ontario Typical Range

Pentachlorophenol in Class 1 Soils

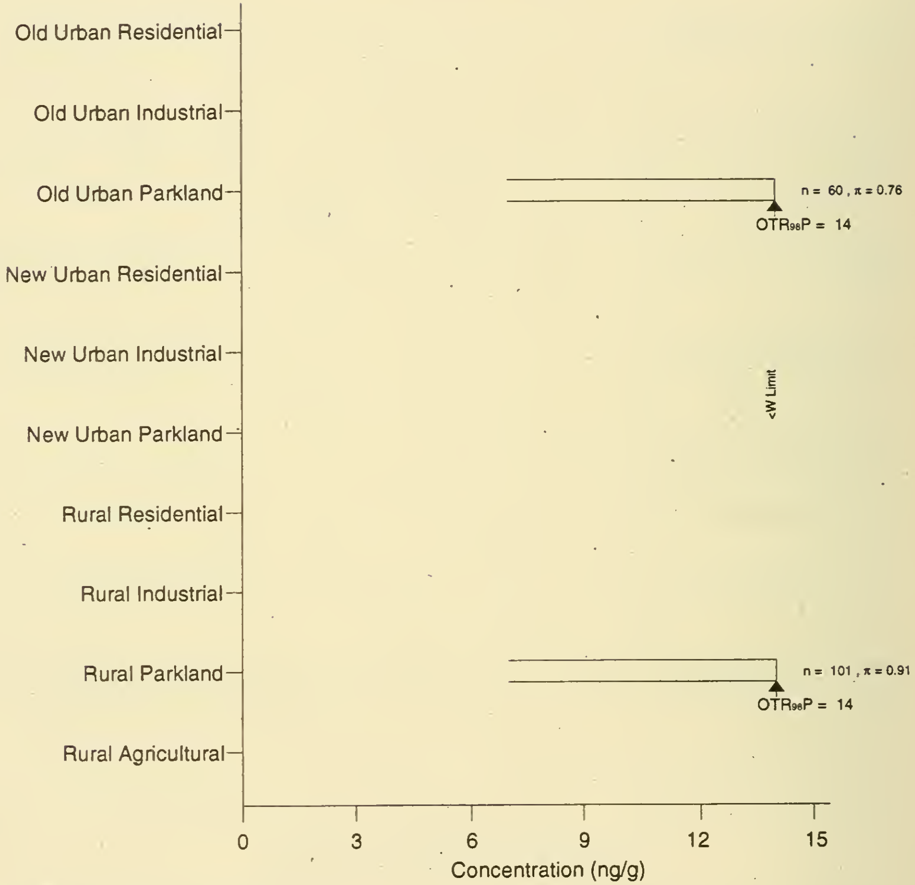


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.131

Ontario Typical Range

4-Chloro-3-methylphenol in Class 1 Soils

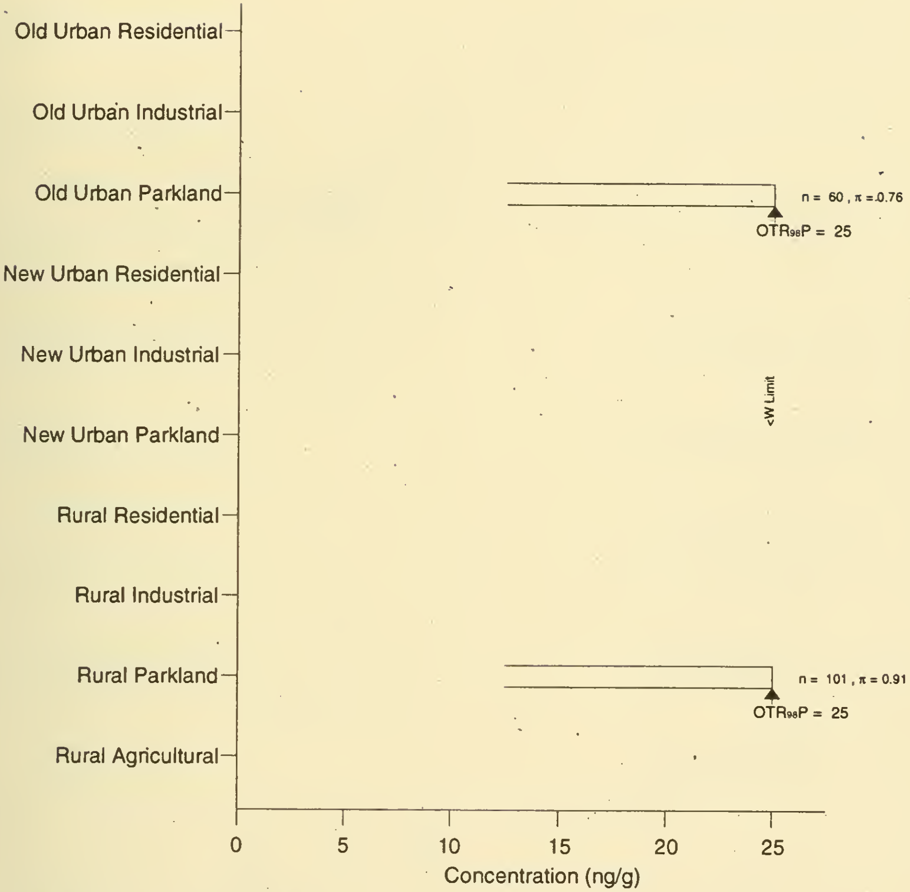


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.132

Ontario Typical Range

2,4-Dimethylphenol in Class 1 Soils

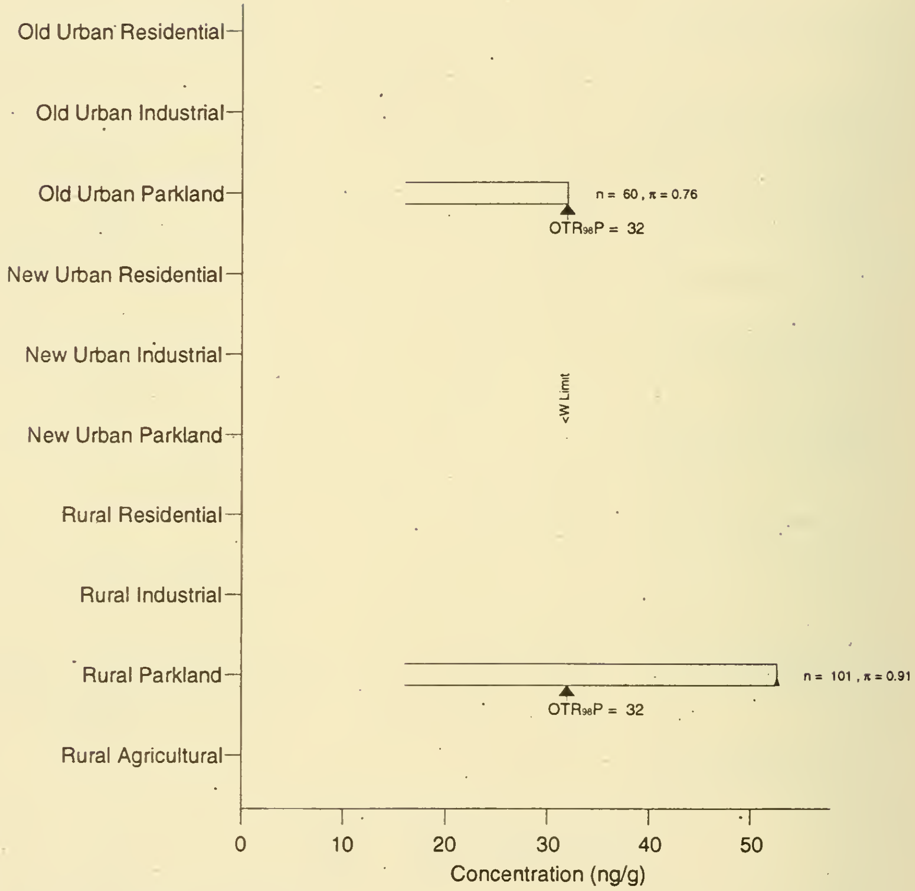


$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

Figure 6.1.133

Ontario Typical Range

4-Nitrophenol in Class 1 Soils

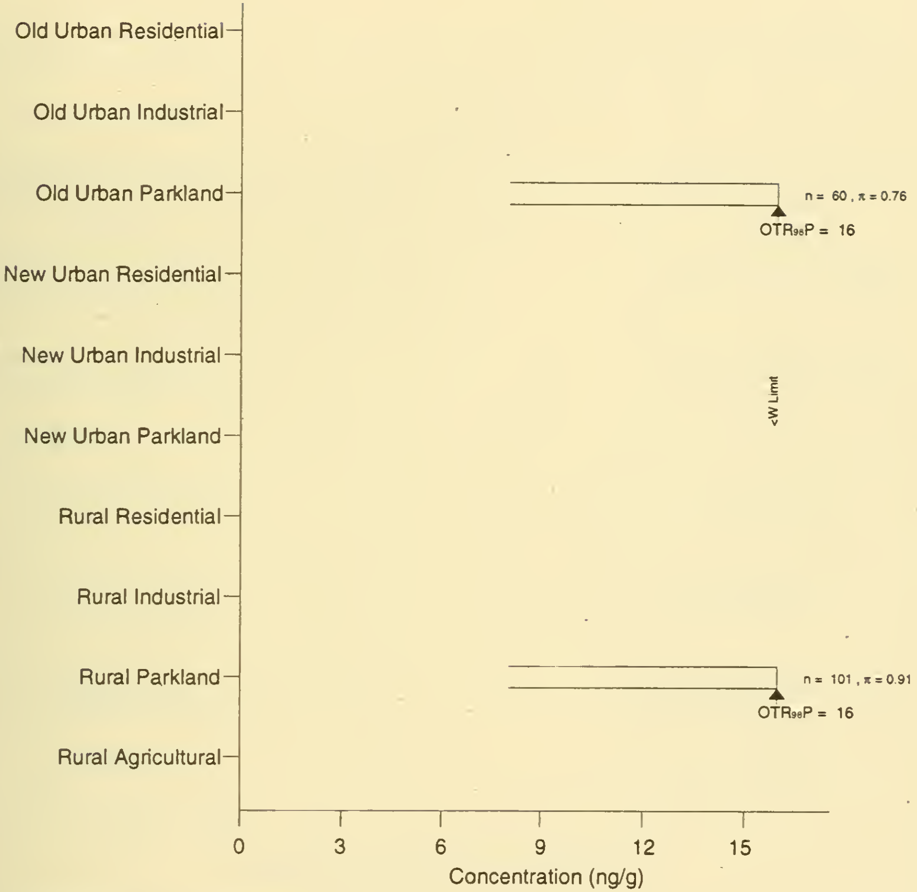


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.134

Ontario Typical Range

2,4-Dinitrophenol in Class 1 Soils

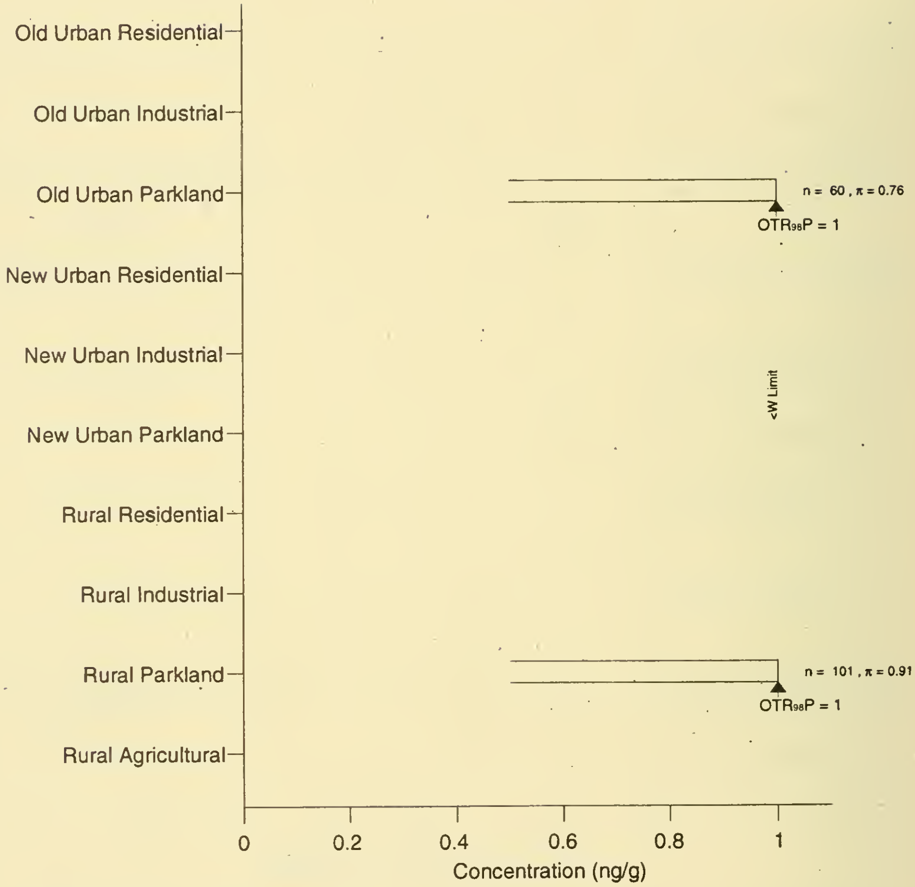


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.135

Ontario Typical Range

Aldrin in Class 1 Soils

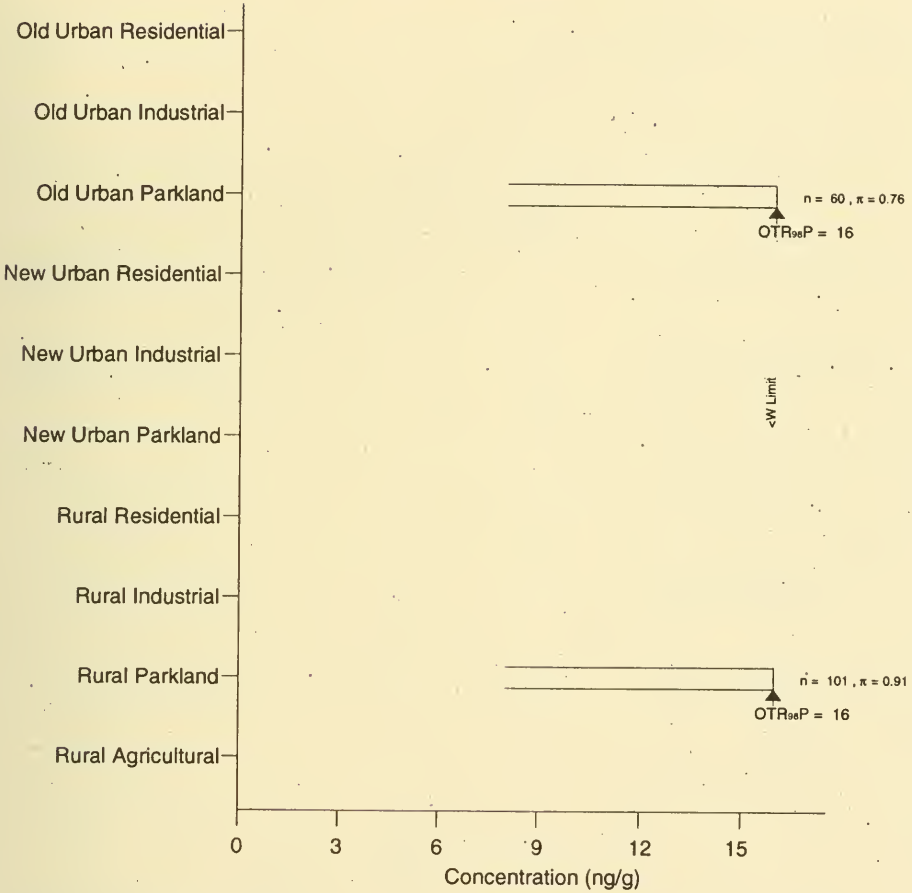


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.136

Ontario Typical Range

Carbaryl in Class 1 Soils

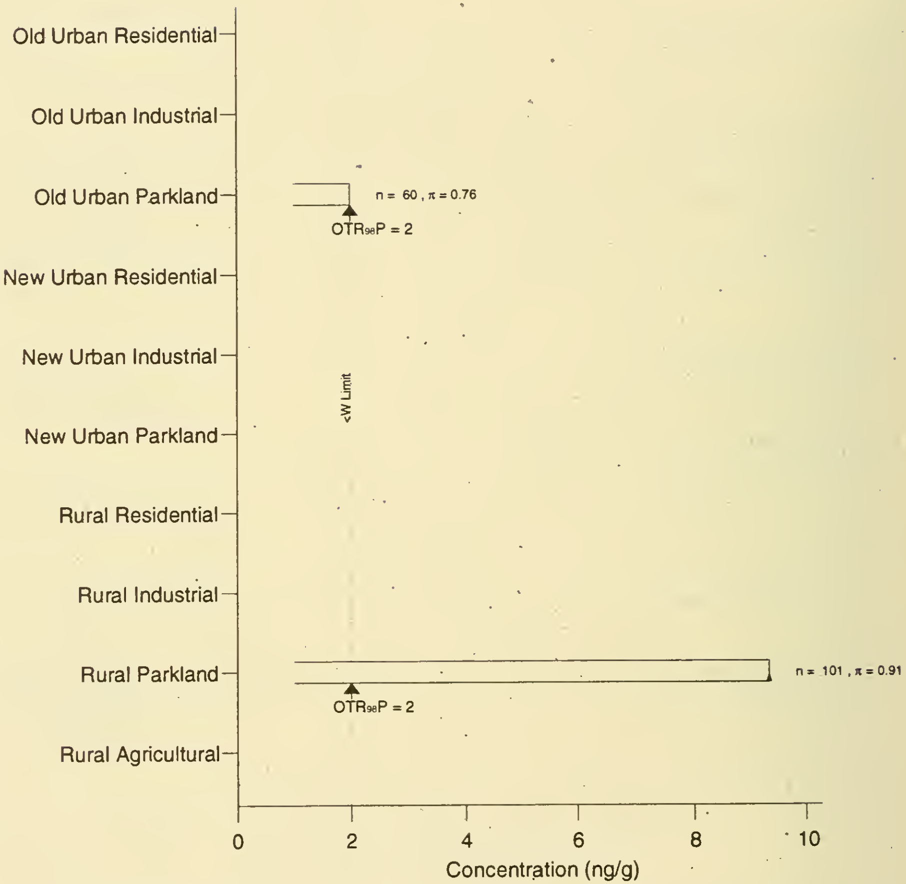


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.137

Ontario Typical Range

a-Chlordane in Class 1 Soils

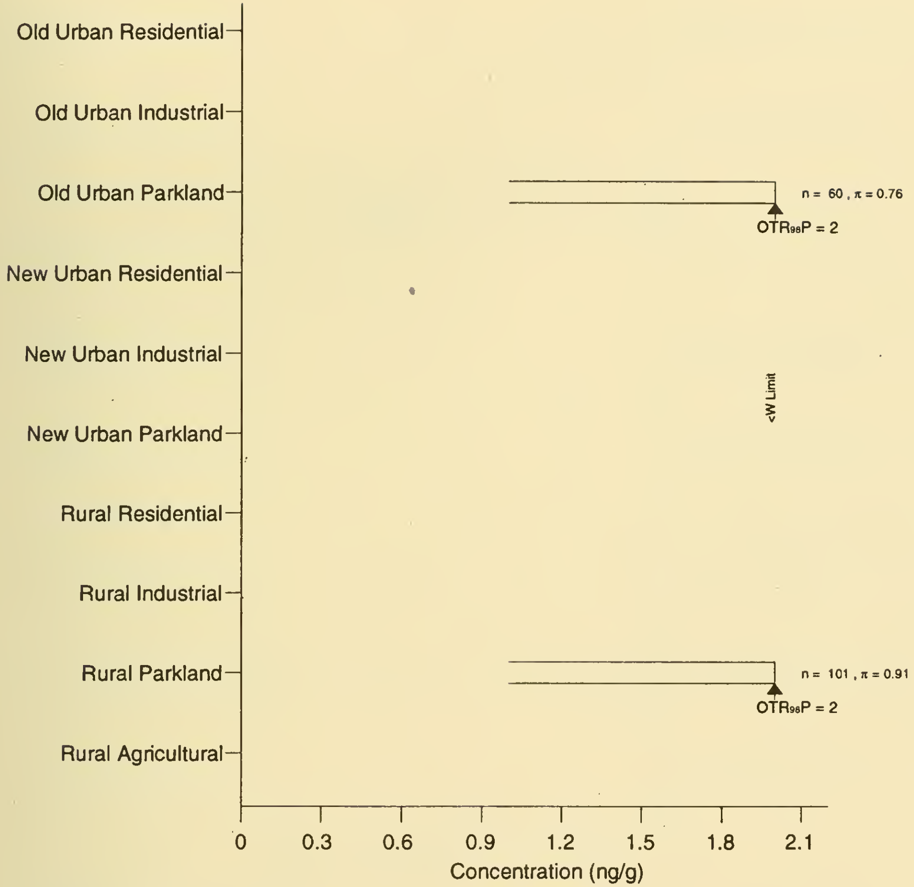


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.138

Ontario Typical Range

g-Chlordane in Class 1 Soils

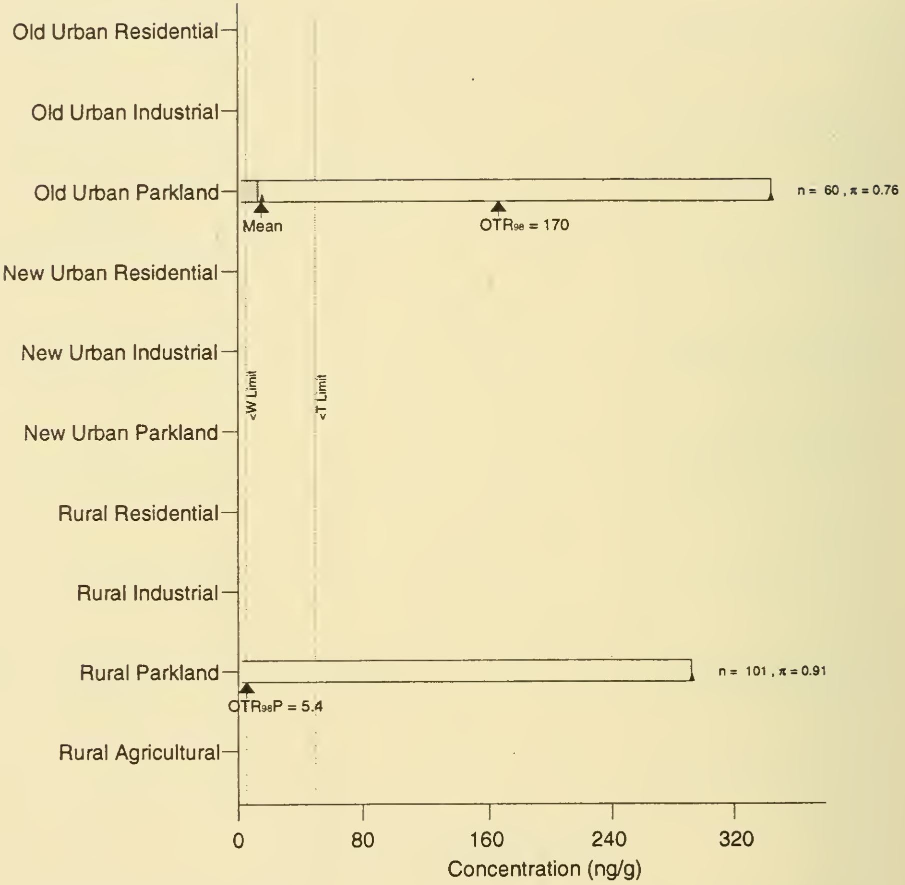


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.139

Ontario Typical Range

O,P-DDT in Class 1 Soils



OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.140

Ontario Typical Range

P,P-DDT in Class 1 Soils

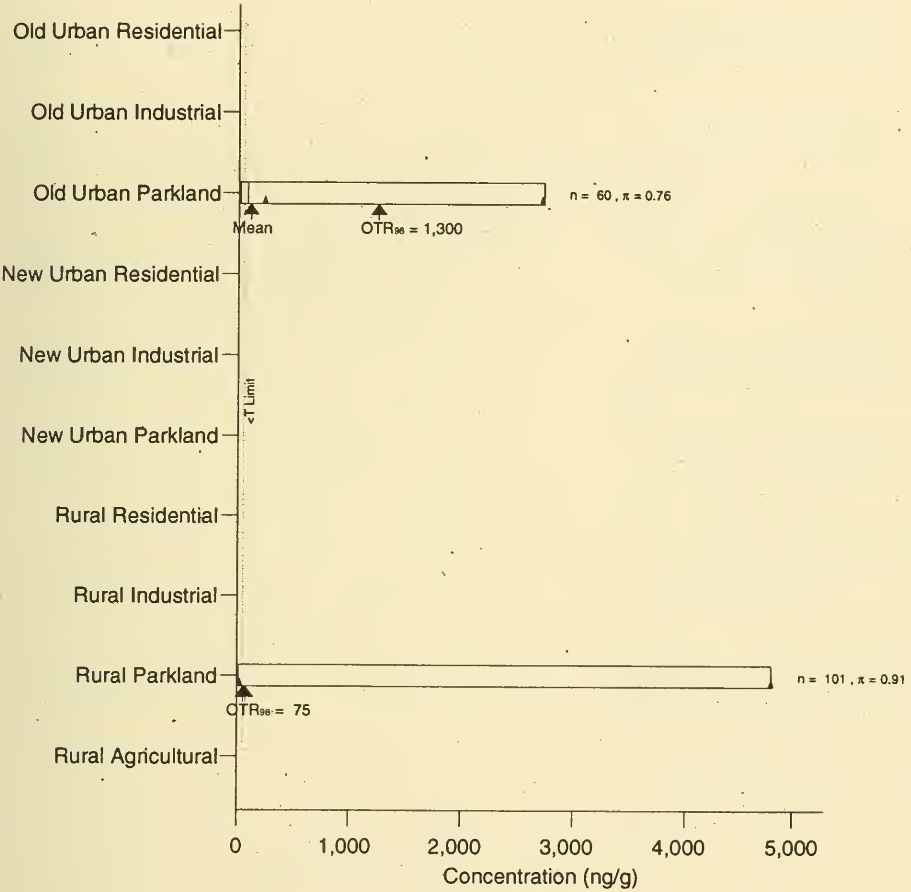


Figure 6.1.141

Ontario Typical Range

DDT in Class 1 Soils

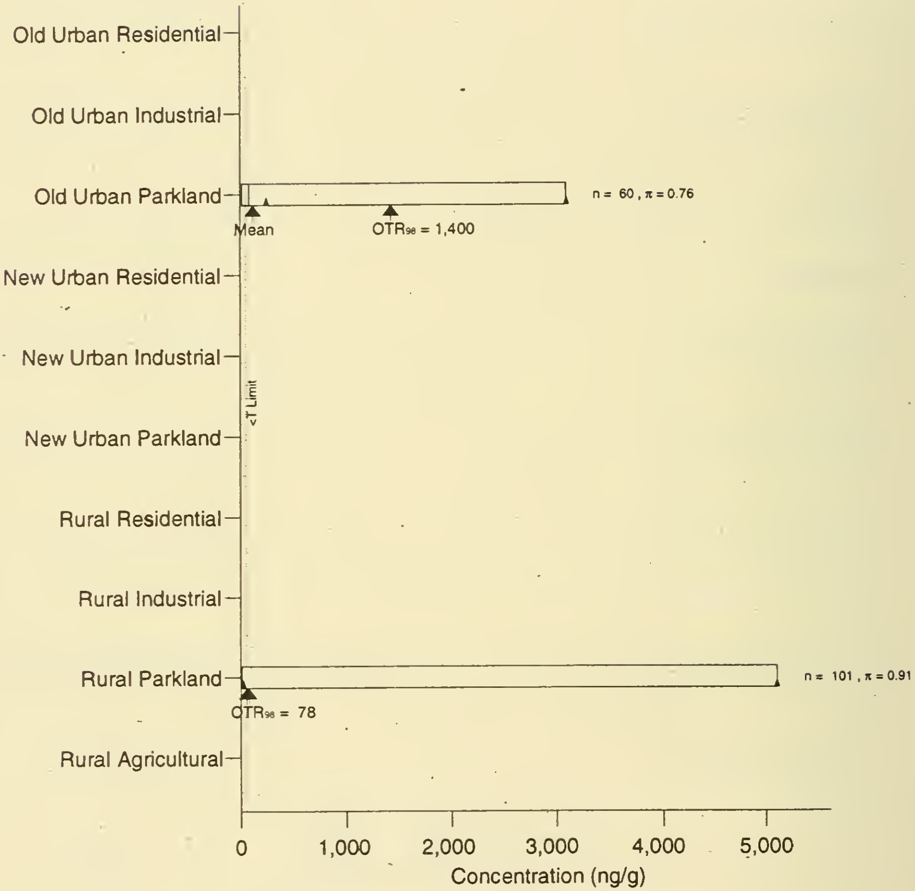
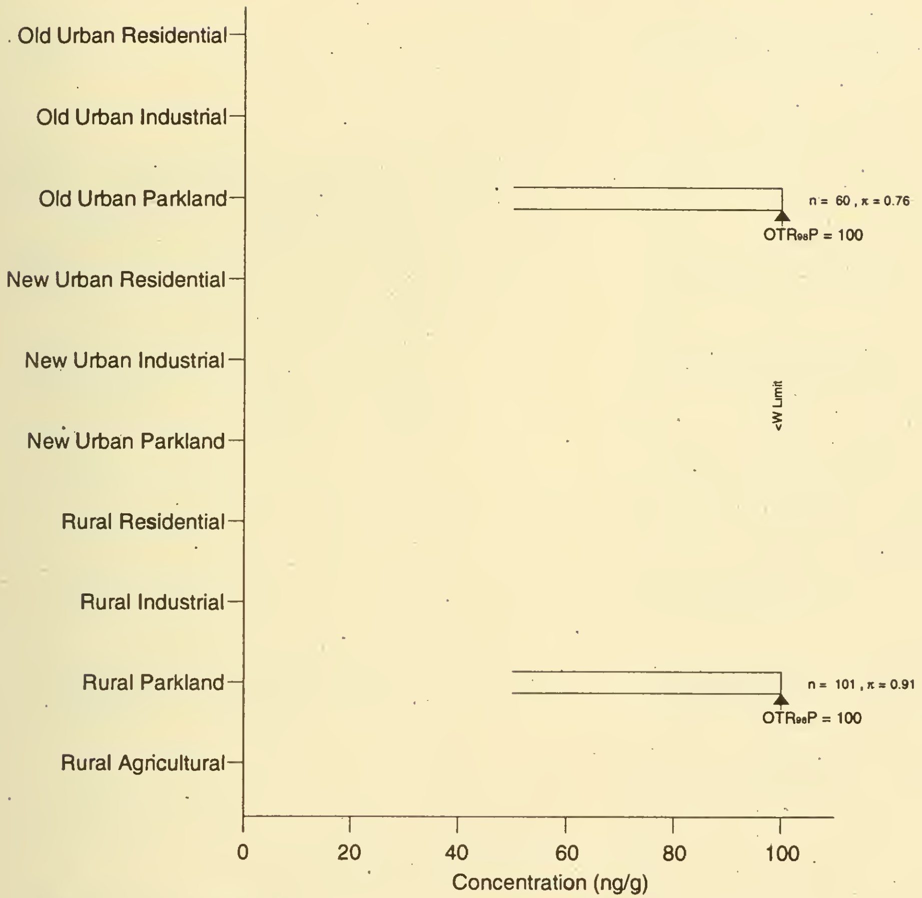


Figure 6.1.142

Ontario Typical Range

2,4-Dichlorophenoxyacetic in Class 1 Soils

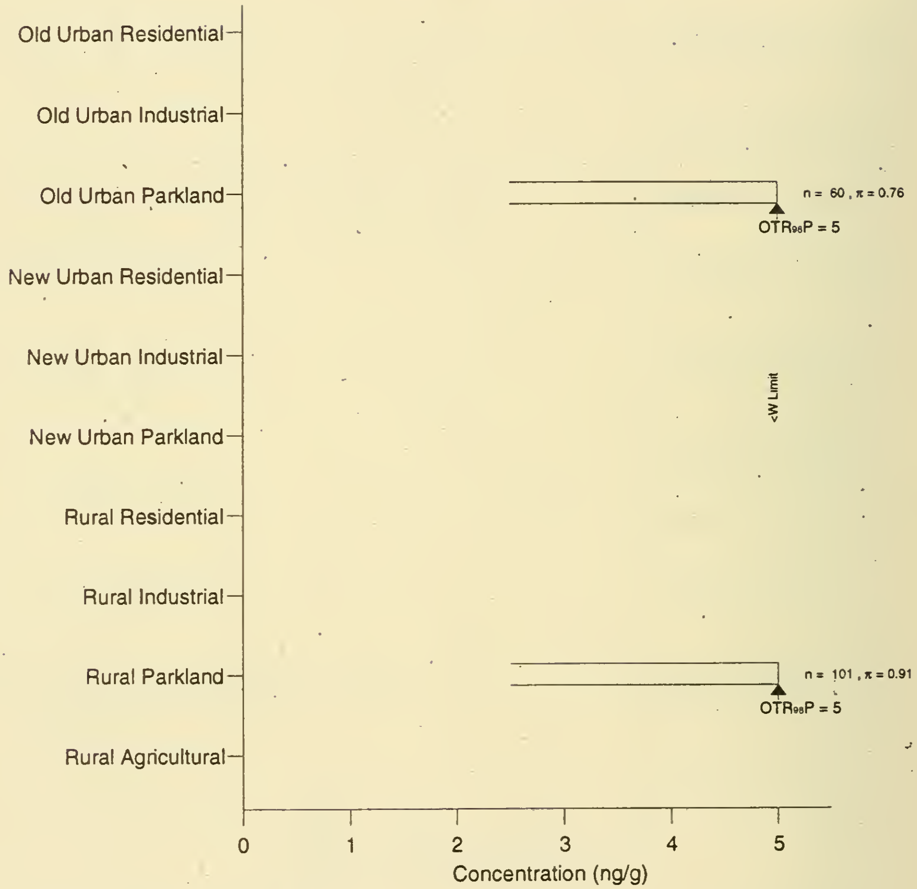


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.143

Ontario Typical Range

Diazinon in Class 1 Soils

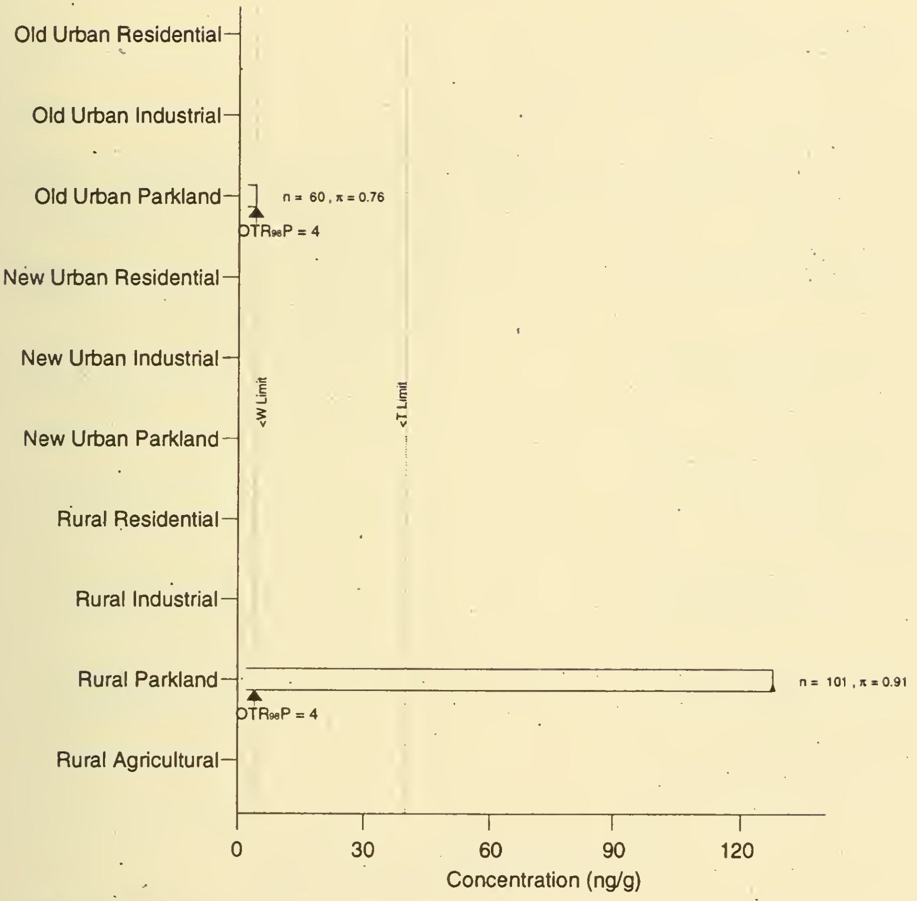


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.144

Ontario Typical Range

Dieldrin in Class 1 Soils

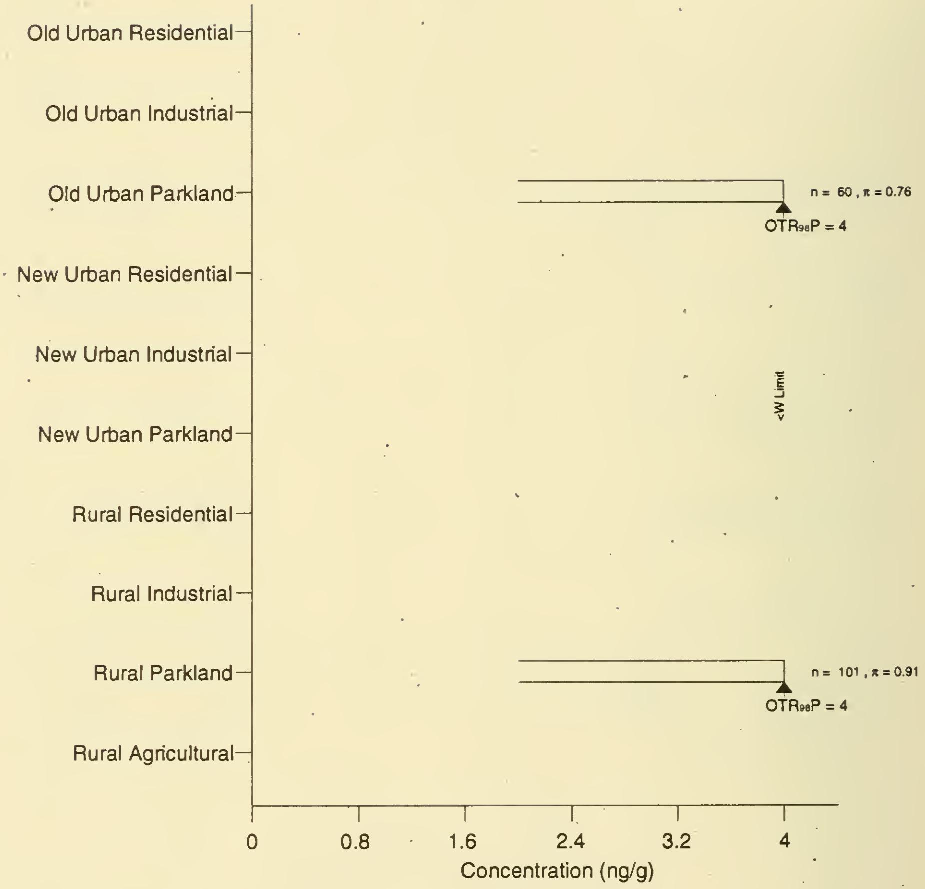


OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.145

Ontario Typical Range

Endrin in Class 1 Soils

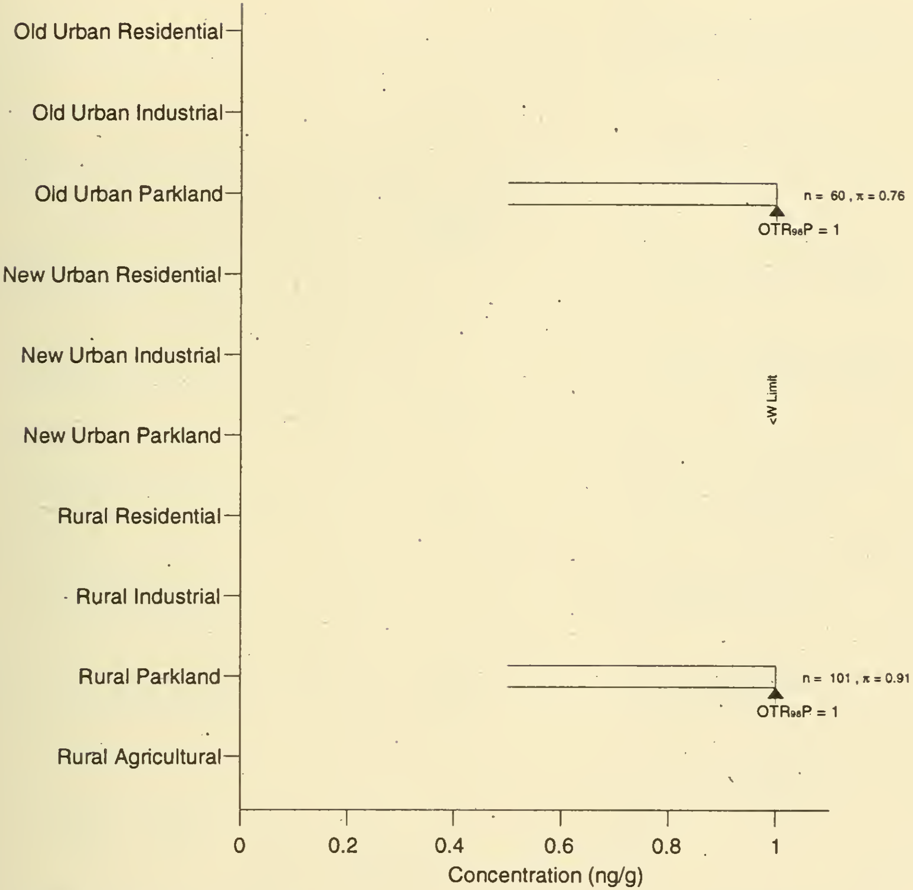


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.146

Ontario Typical Range

Heptachlor in Class 1 Soils

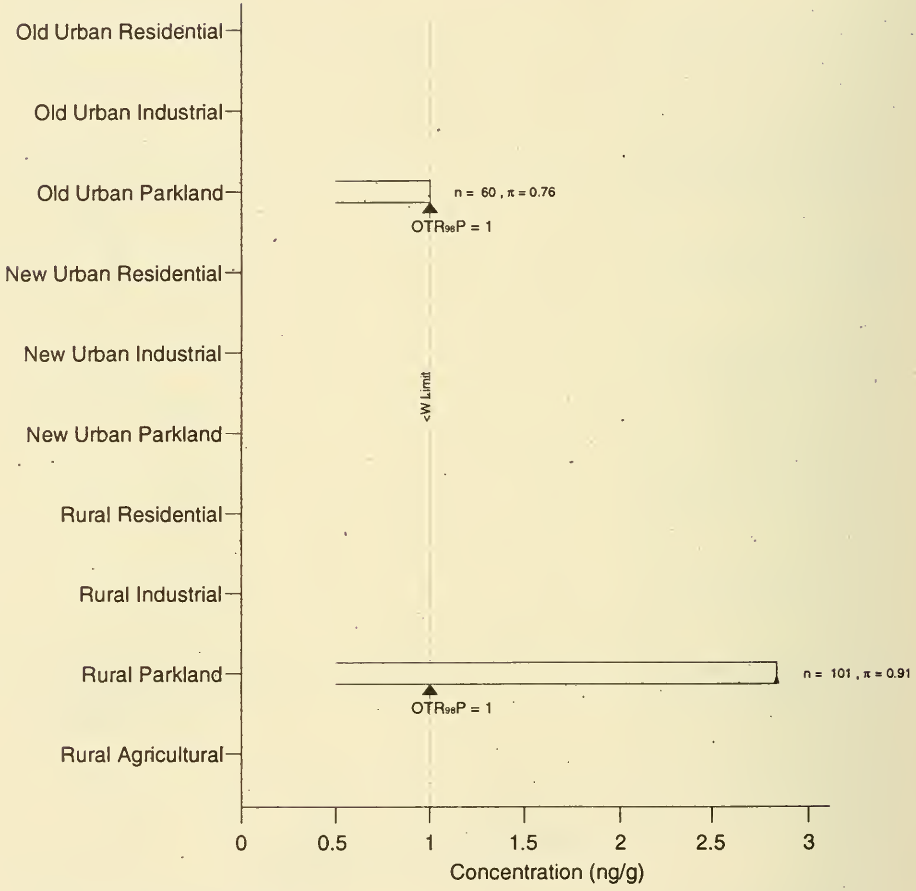


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.147

Ontario Typical Range

Heptachlorepoxide in Class 1 Soils

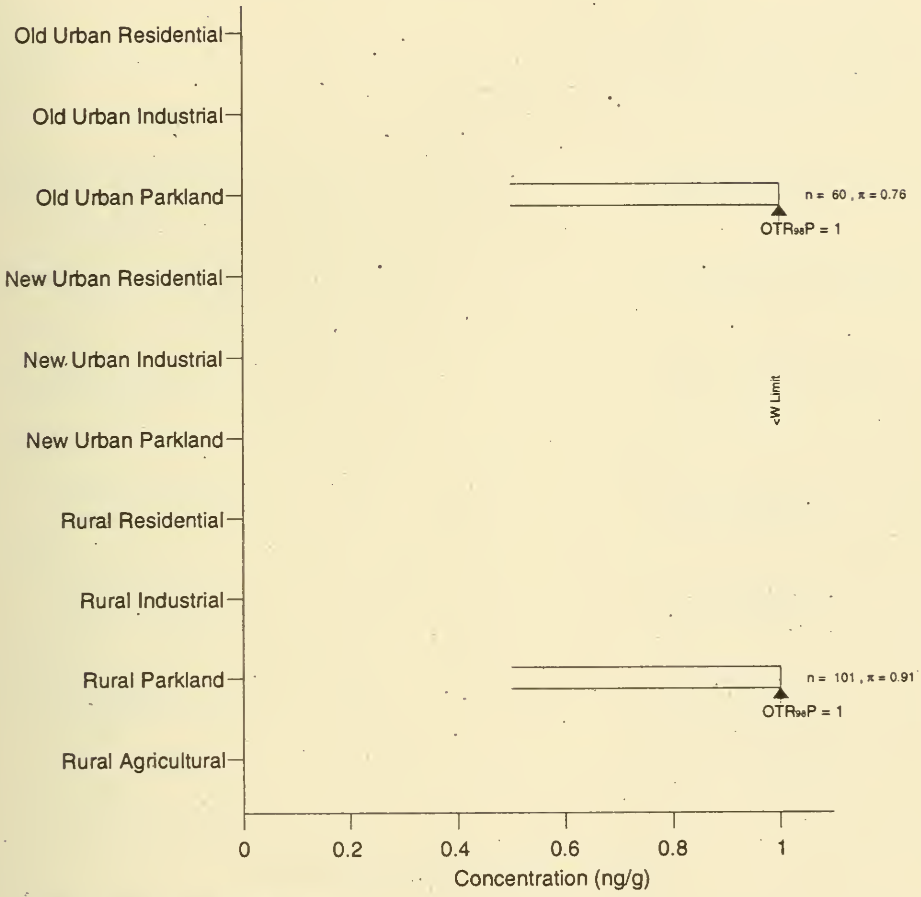


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.148

Ontario Typical Range

Lindane (g-BHC Hexachlorocyc.) in Class 1 Soils

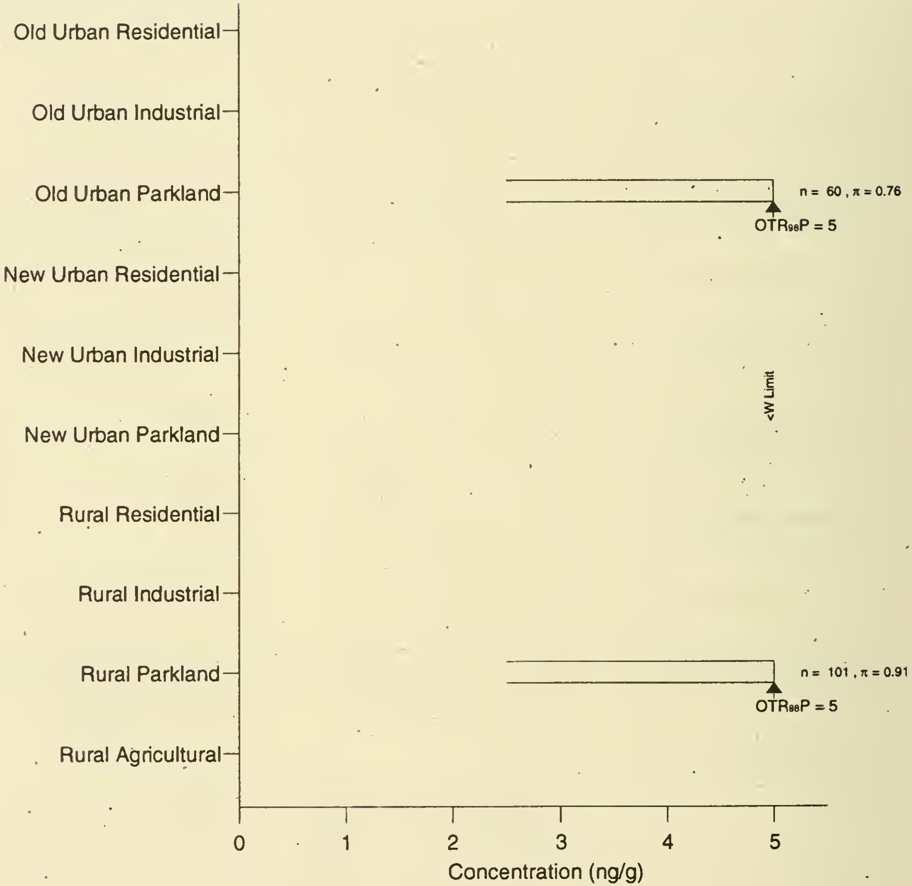


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.149

Ontario Typical Range

Methoxychlor in Class 1 Soils

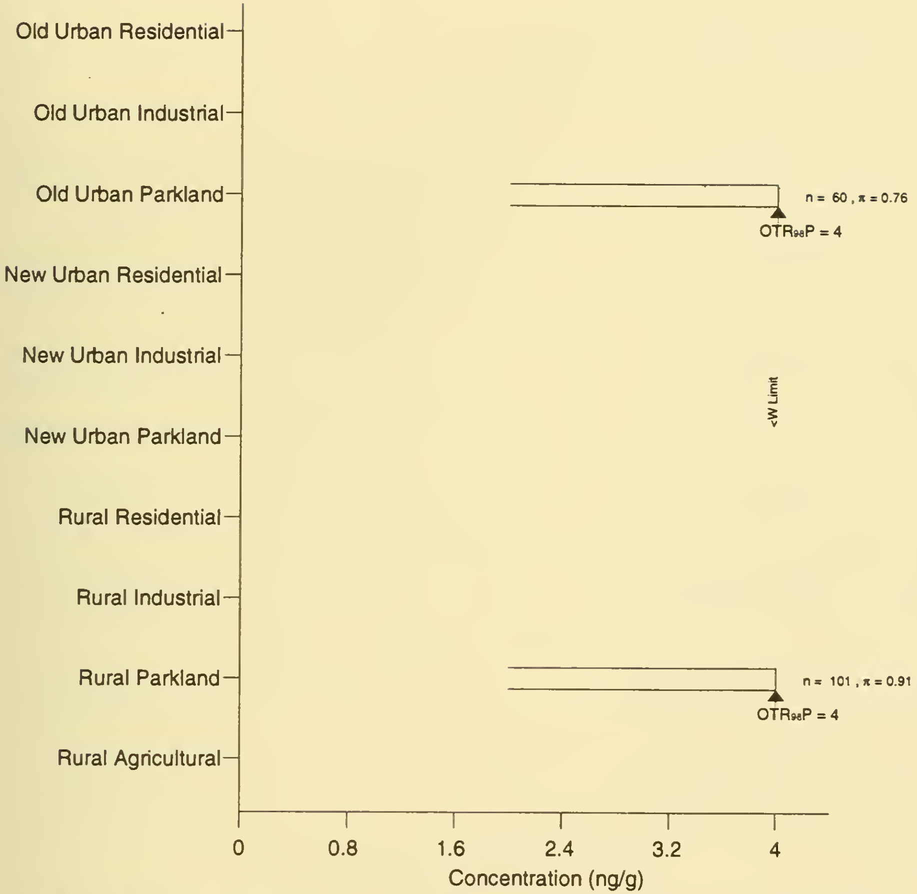


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.150

Ontario Typical Range

Methylparathion in Class 1 Soils

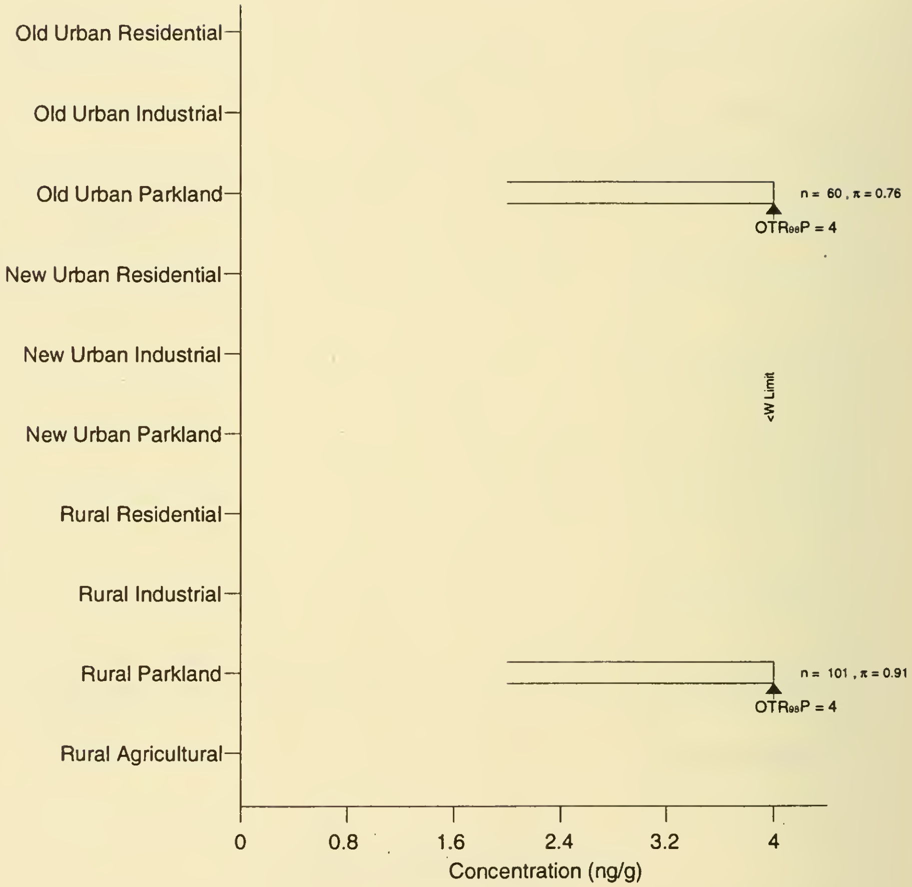


OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.151

Ontario Typical Range

Parathion in Class 1 Soils

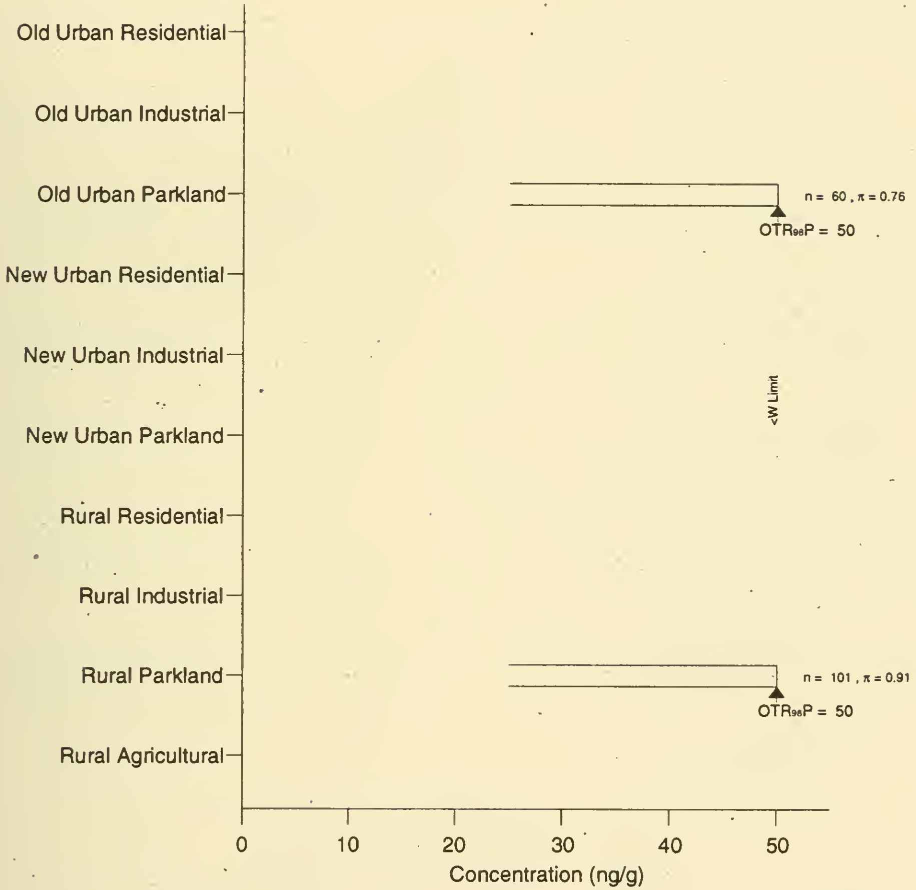


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.152

Ontario Typical Range

Silvex in Class 1 Soils

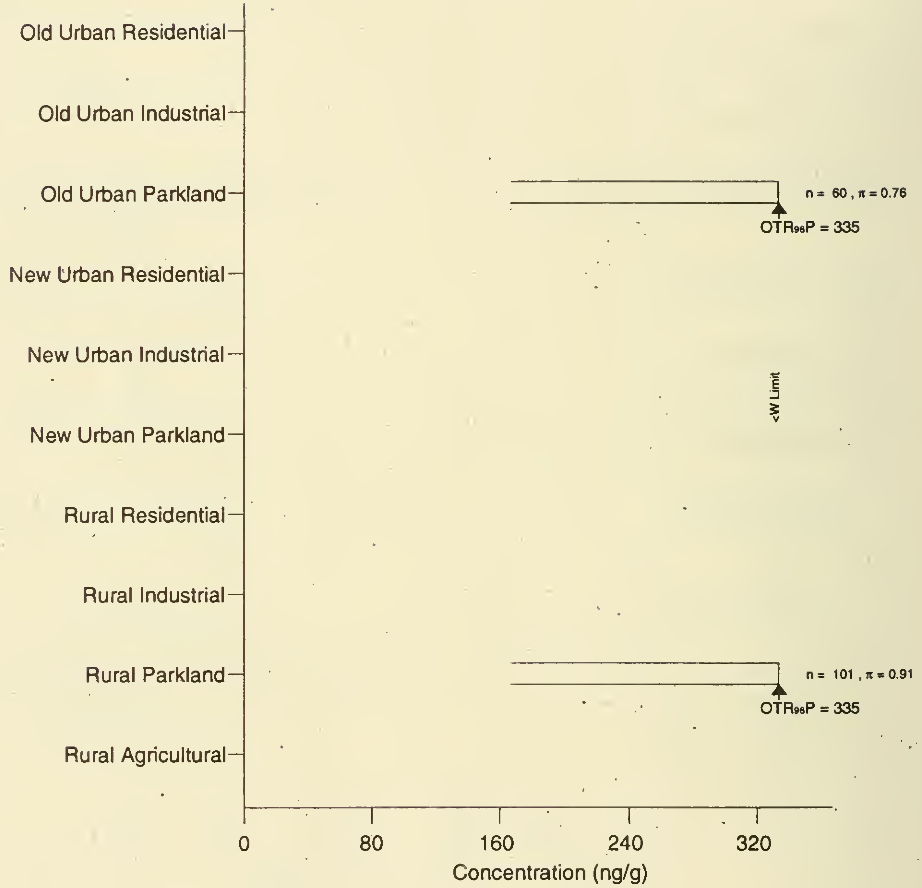


OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.153

Ontario Typical Range

Toxaphene in Class 1 Soils

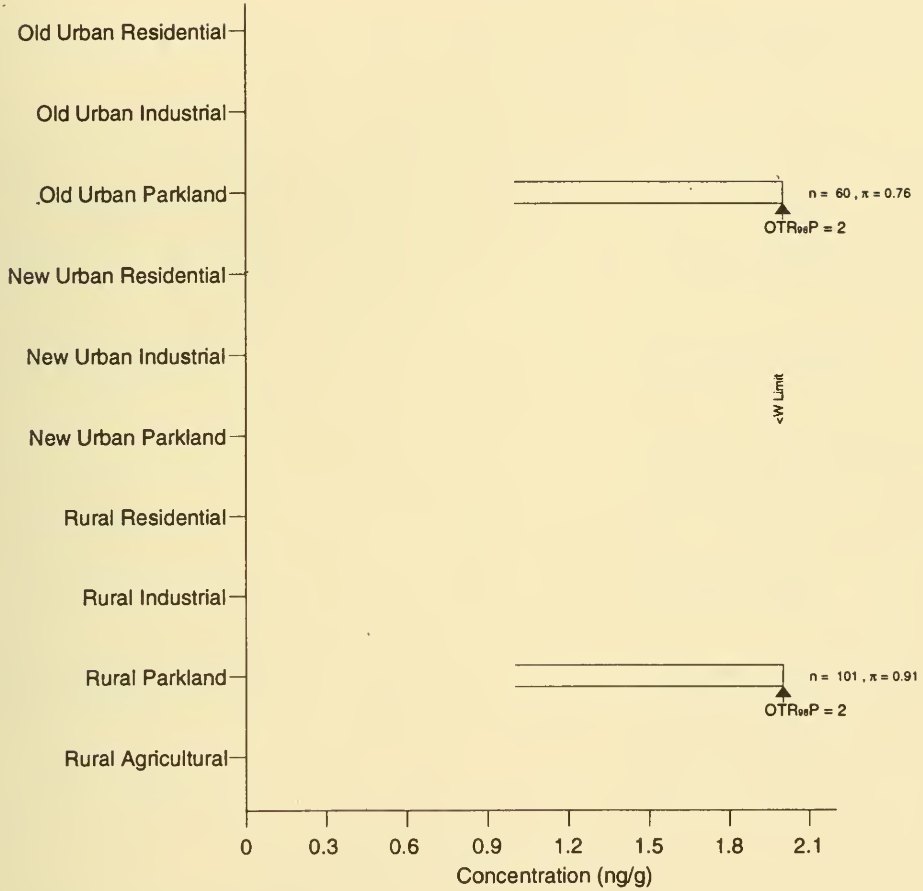


OTR98P - Provisional OTR98, insufficient data >W

Figure 6.1.154

Ontario Typical Range

Monochlorinated Biphenyls in Class 1 Soils

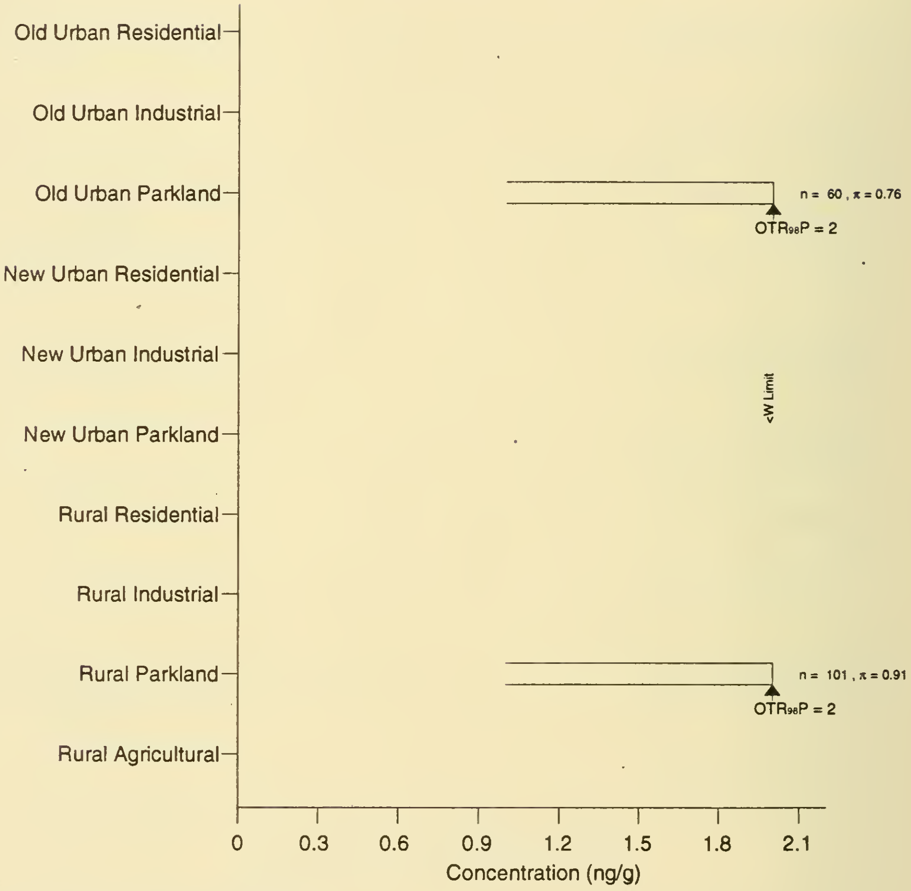


$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

Figure 6.1.155

Ontario Typical Range

Dichlorinated Biphenyls in Class 1 Soils

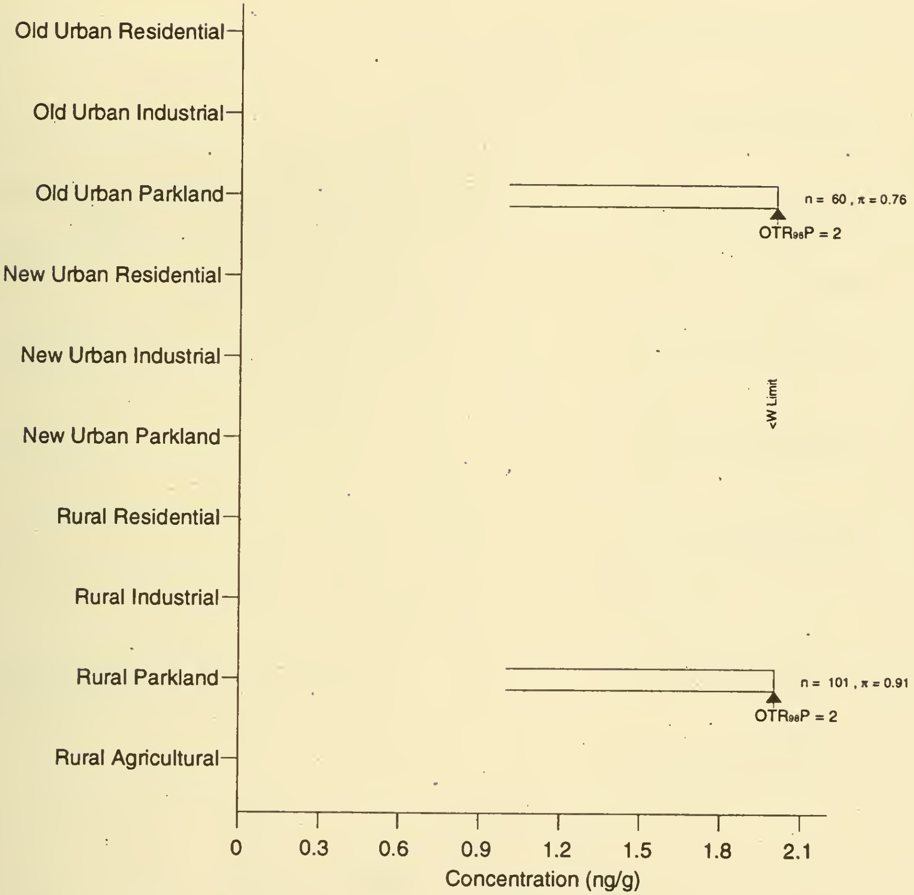


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.156

Ontario Typical Range

Trichlorinated Biphenyls in Class 1 Soils

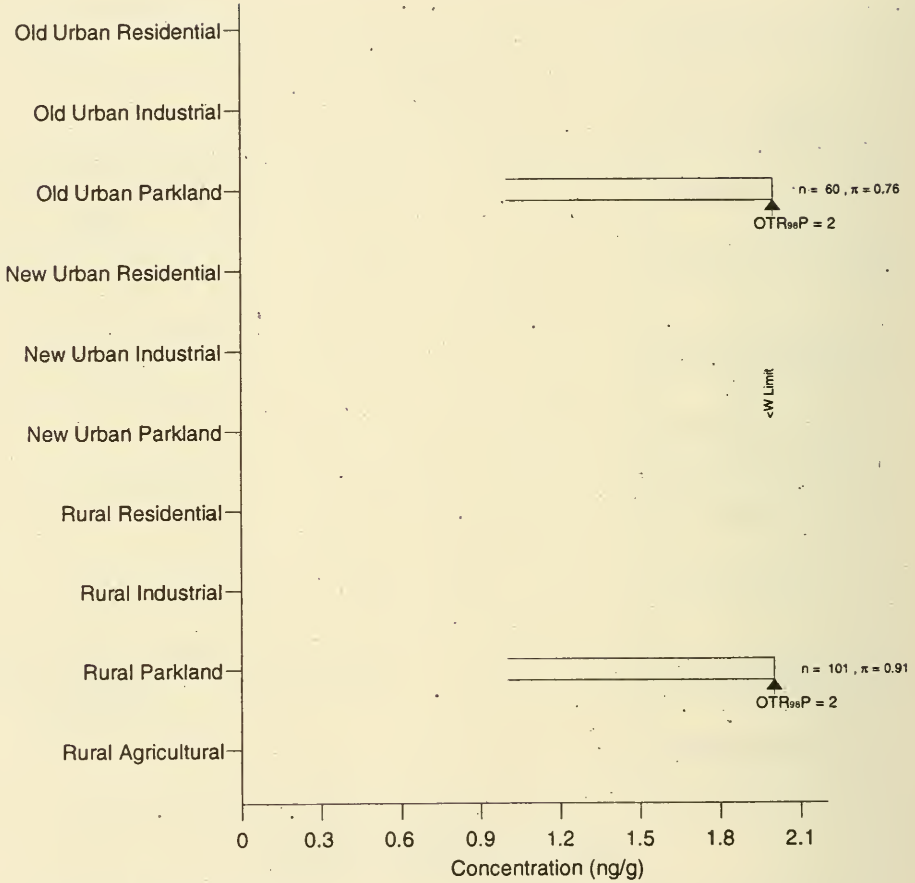


OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.157

Ontario Typical Range

Tetrachlorinated Biphenyls in Class 1 Soils

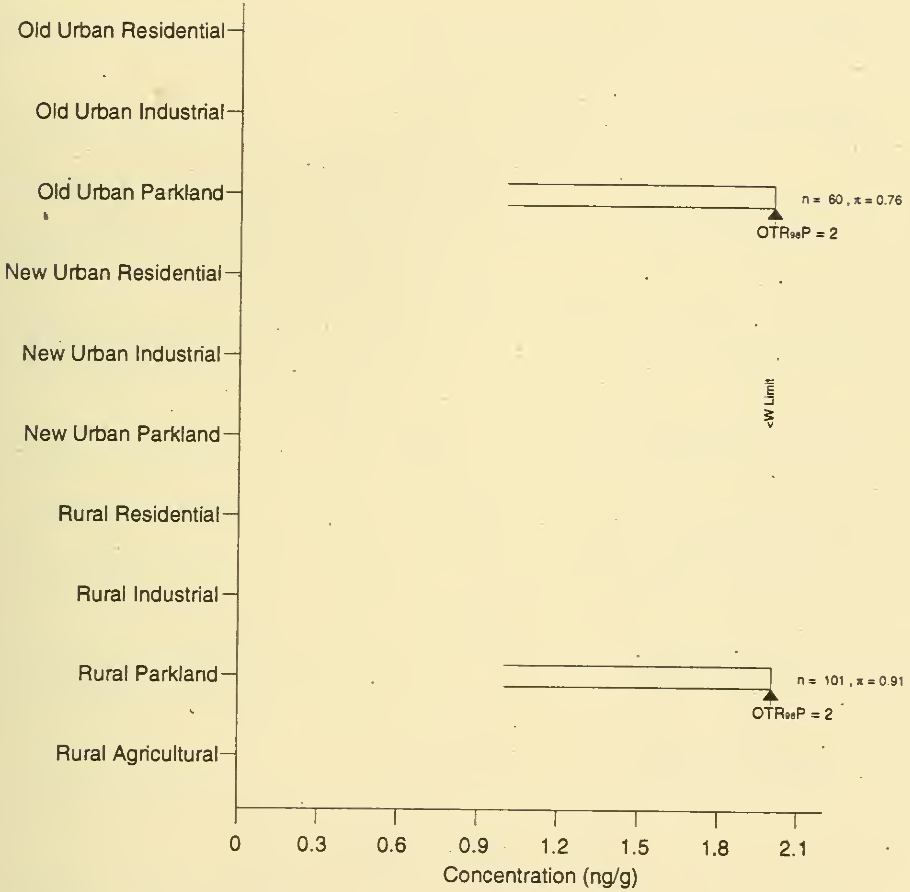


$OTR_{98}P$ - Provisional OTR_{98} , insufficient data >W

Figure 6.1.158

Ontario Typical Range

Pentachlorinated Biphenyls in Class 1 Soils

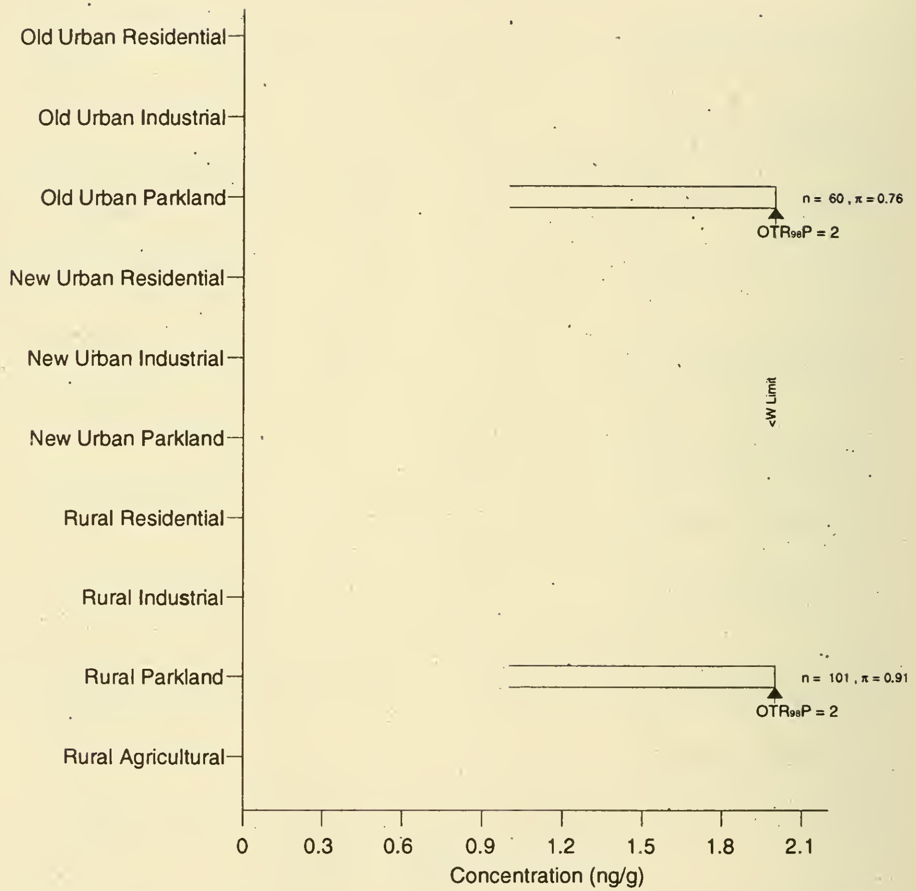


OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.159

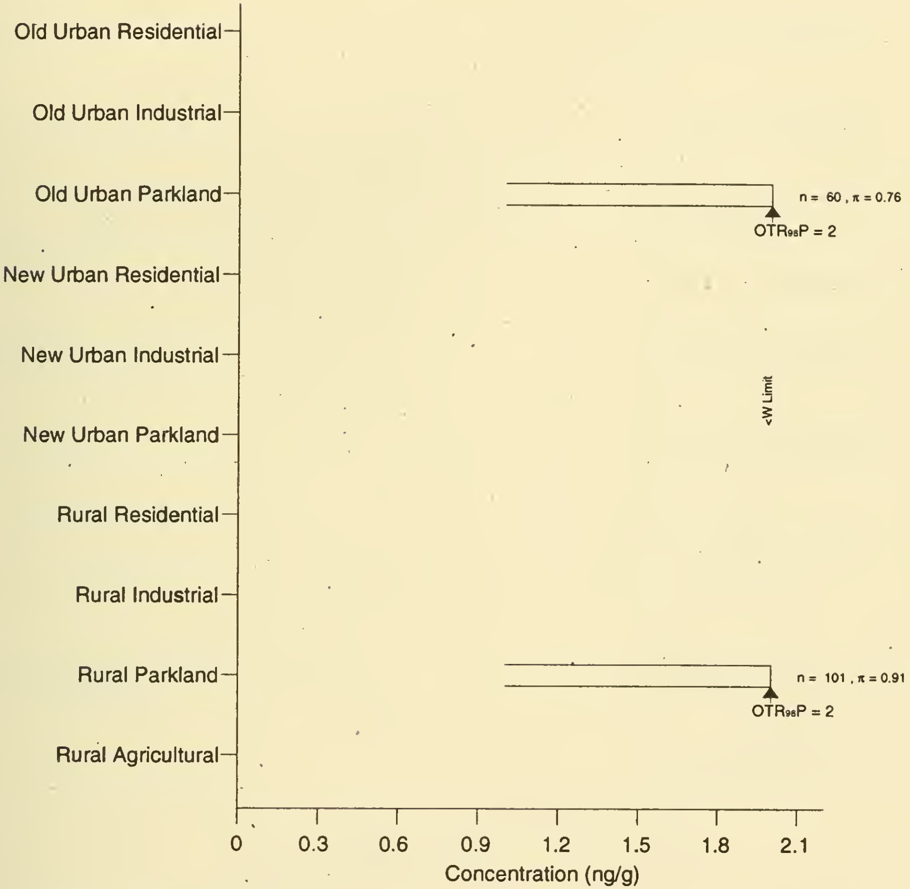
Ontario Typical Range

Hexachlorinated Biphenyls in Class 1 Soils



OTR$_{98}$P - Provisional OTR$_{98}$, insufficient data >W

Figure 6.1.160



Ontario Typical Range

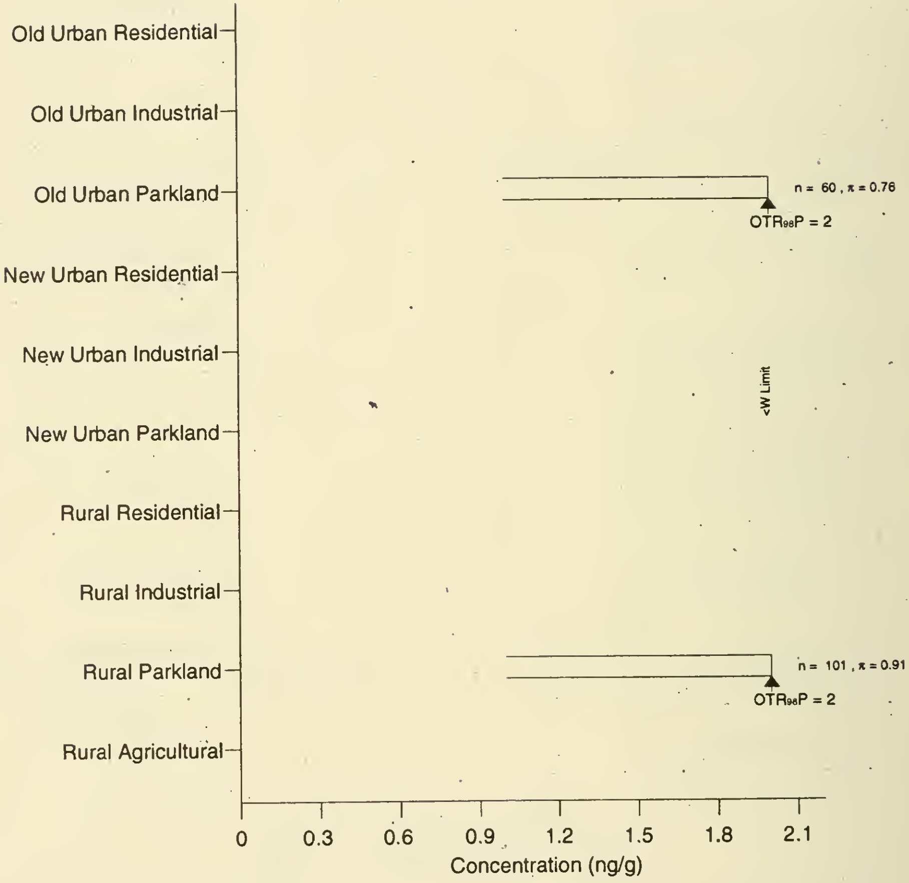
Heptachlorinated Biphenyls in Class 1 Soils

OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.161

Ontario Typical Range

Octachlorinated Biphenyls in Class 1 Soils

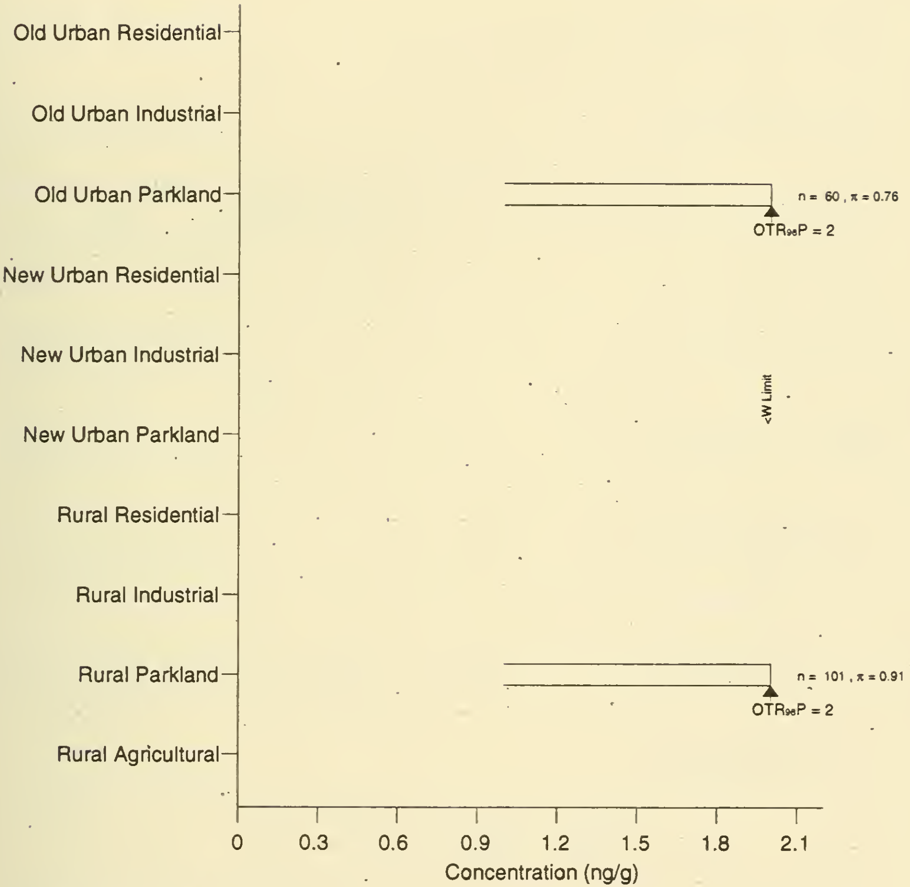


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.162

Ontario Typical Range

Nonachlorinated Biphenyls in Class 1 Soils

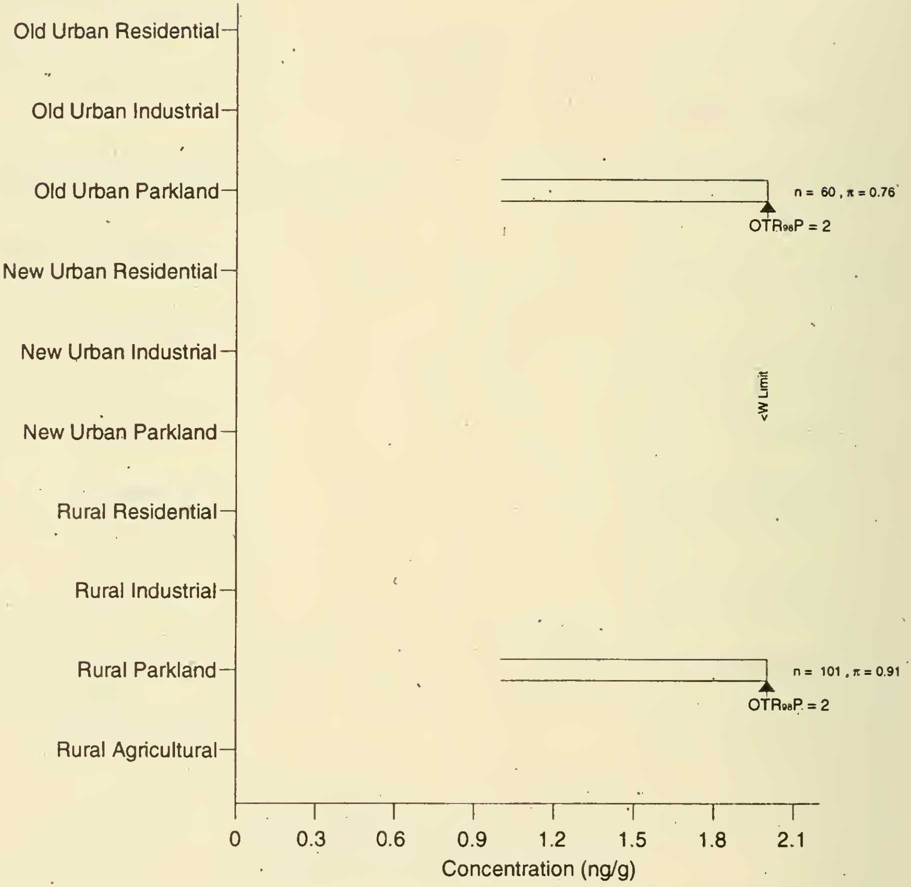


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.163

Ontario Typical Range

Decachlorinated Biphenyls in Class 1 Soils

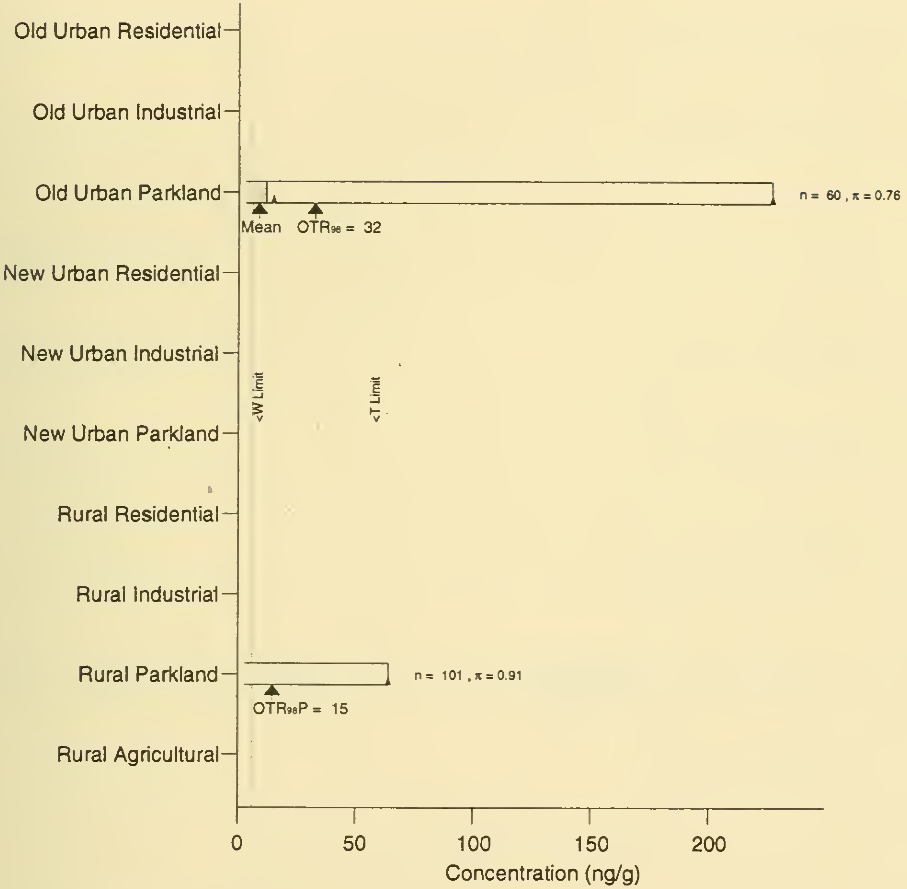


OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.164

Ontario Typical Range

PCB, Total in Class 1 Soils



OTR98P - Provisional OTR98 , insufficient data >W

Figure 6.1.165

Ontario Typical Range

Tetrachlorodibenzofurans in Class 1 Soils

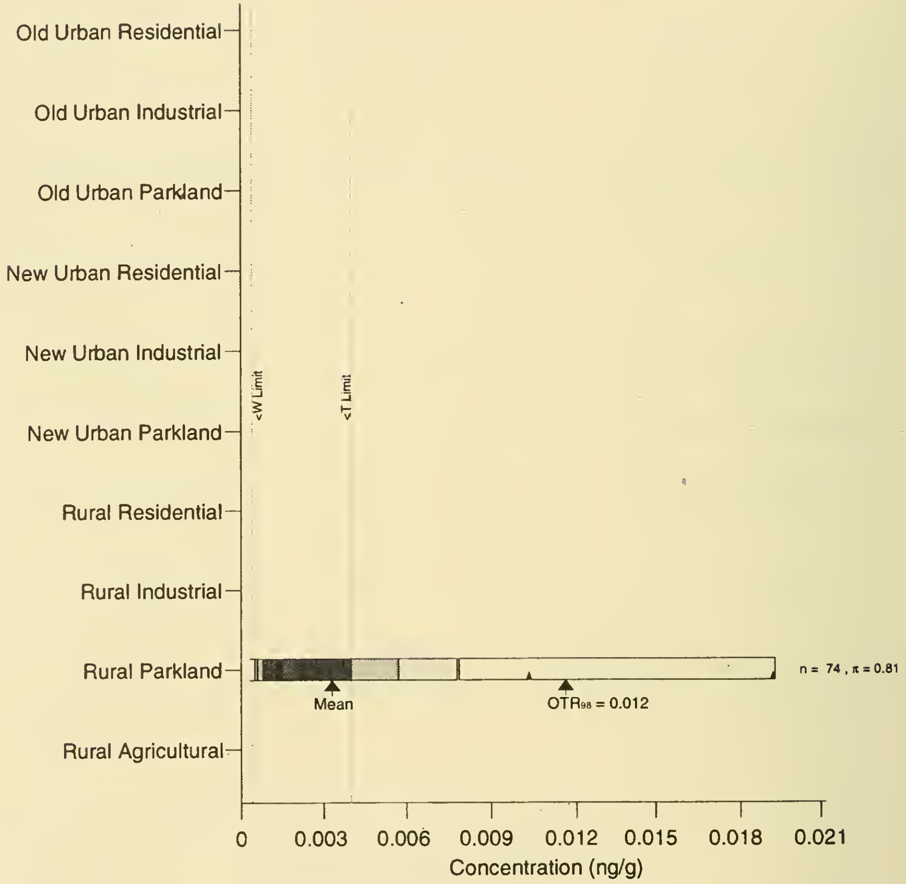


Figure 6.1.166

Ontario Typical Range

Pentachlorodibenzofurans in Class 1 Soils

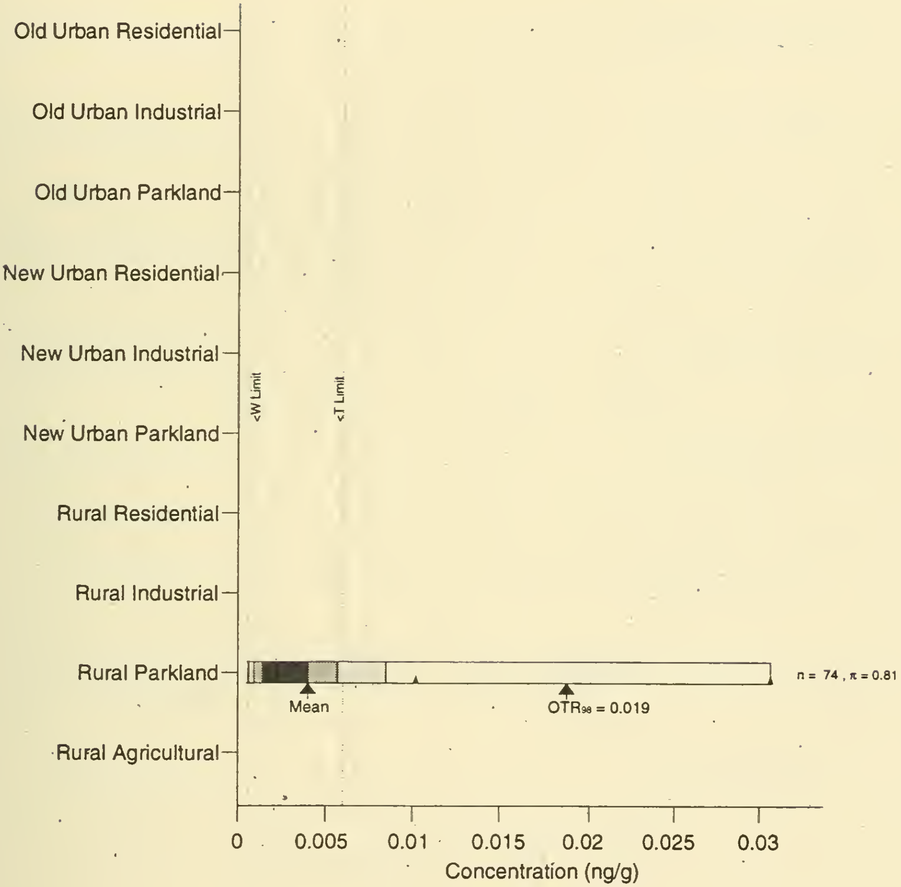


Figure 6.1.167

Ontario Typical Range

Hexachlorodibenzofurans in Class 1 Soils

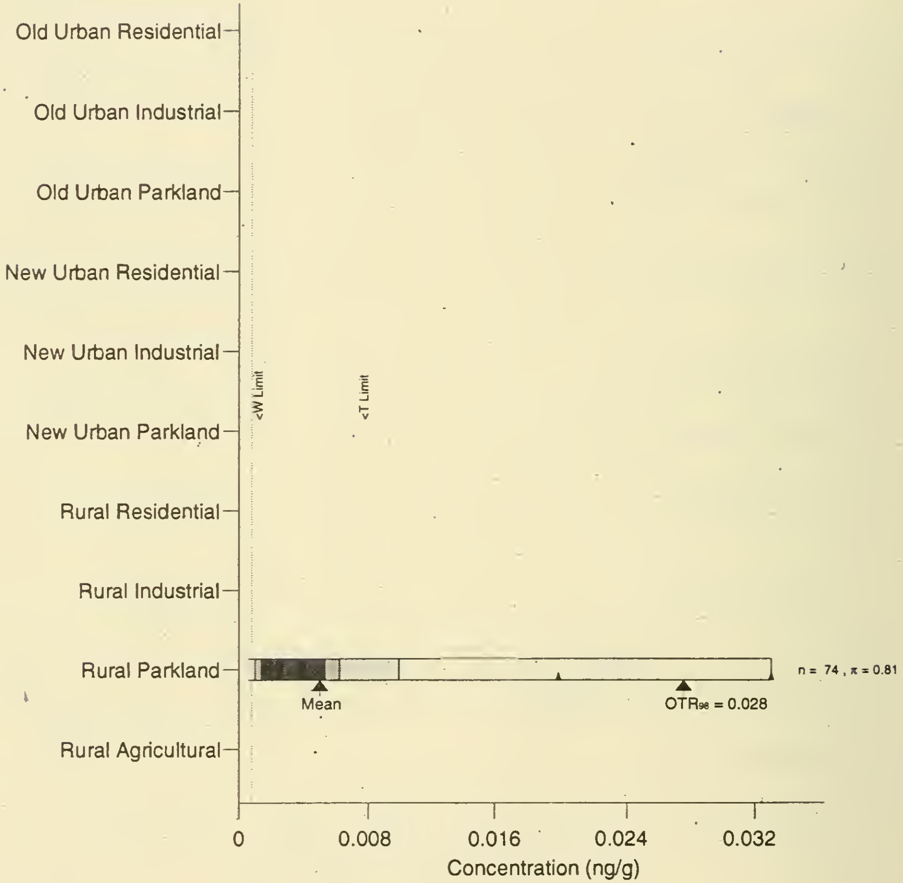


Figure 6.1.168

Ontario Typical Range

Heptachlorodibenzofurans in Class 1 Soils

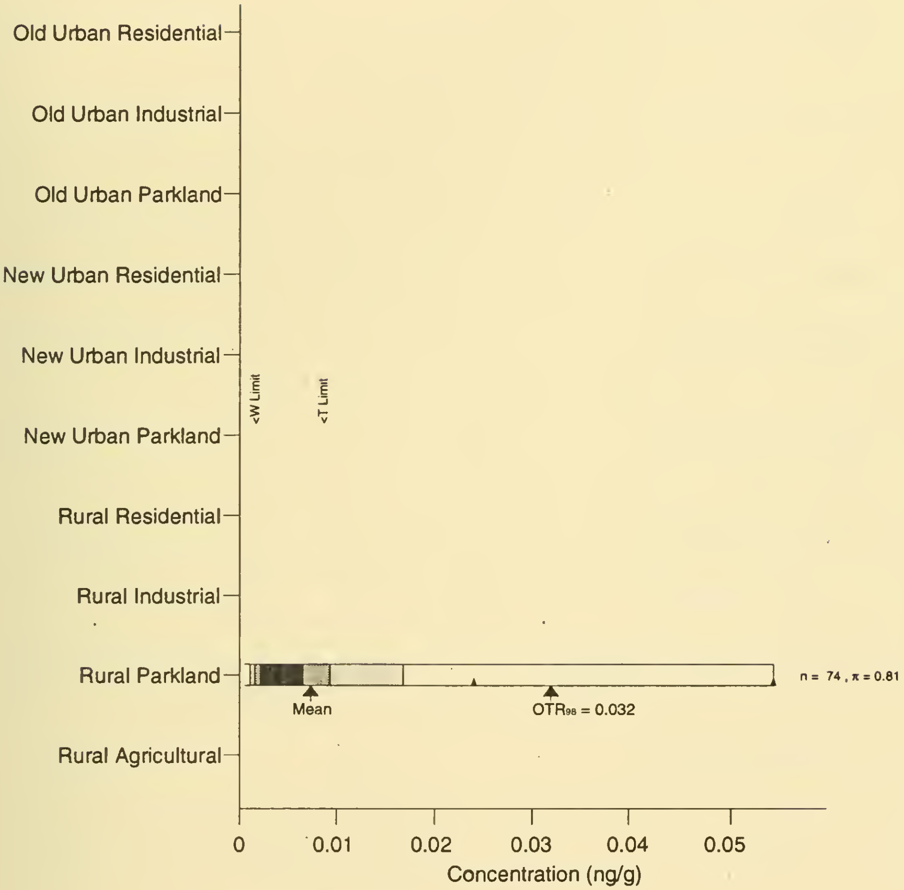


Figure 6.1.169

Ontario Typical Range

Octachlorodibenzofurans in Class 1 Soils

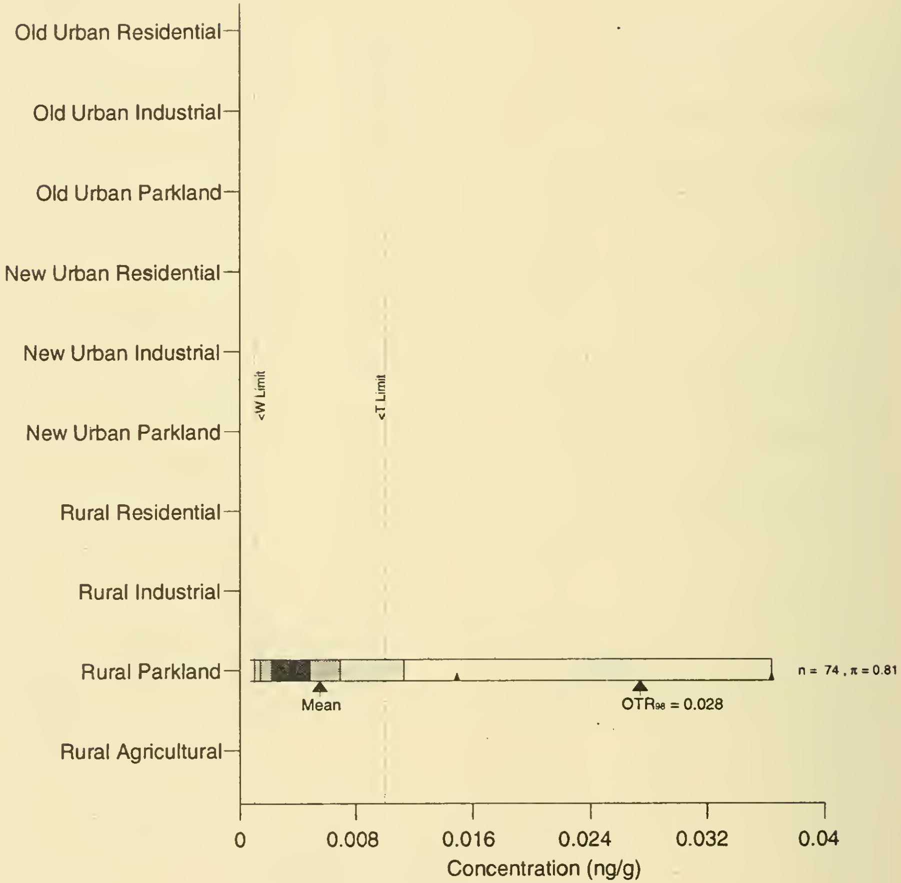


Figure 6.1.170

Ontario Typical Range

Tetrachlorodibenzo-p-dioxins in Class 1 Soils

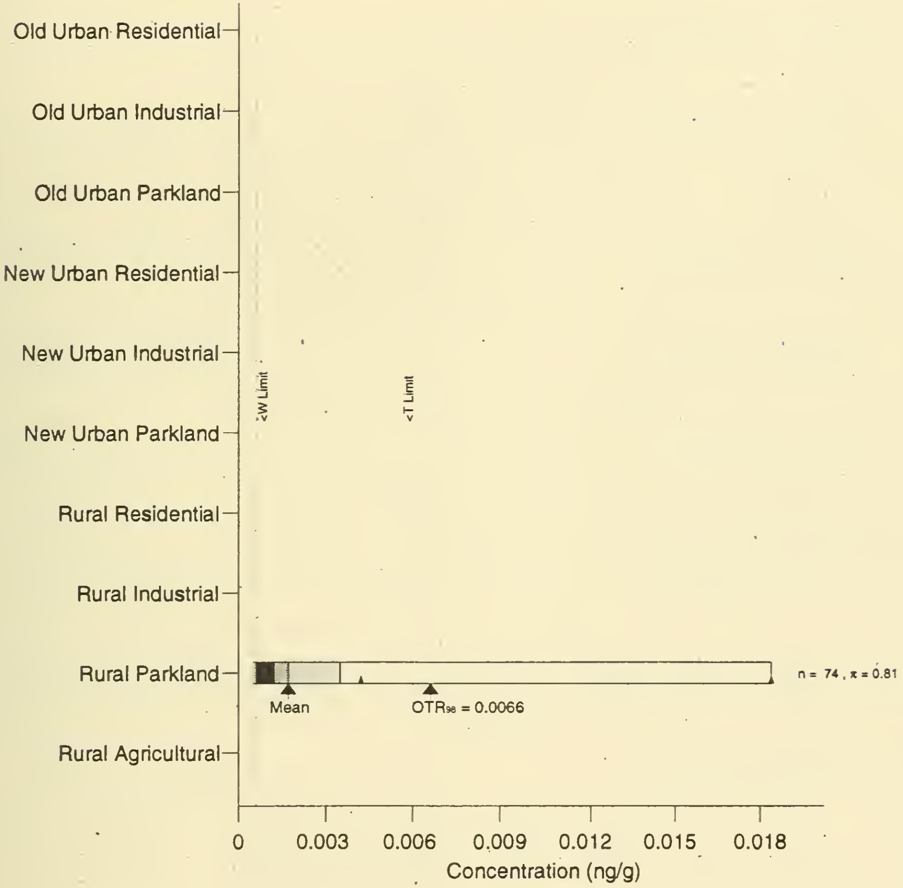


Figure 6.1.171

Ontario Typical Range

Pentachlorodibenzo-p-dioxins in Class 1 Soils

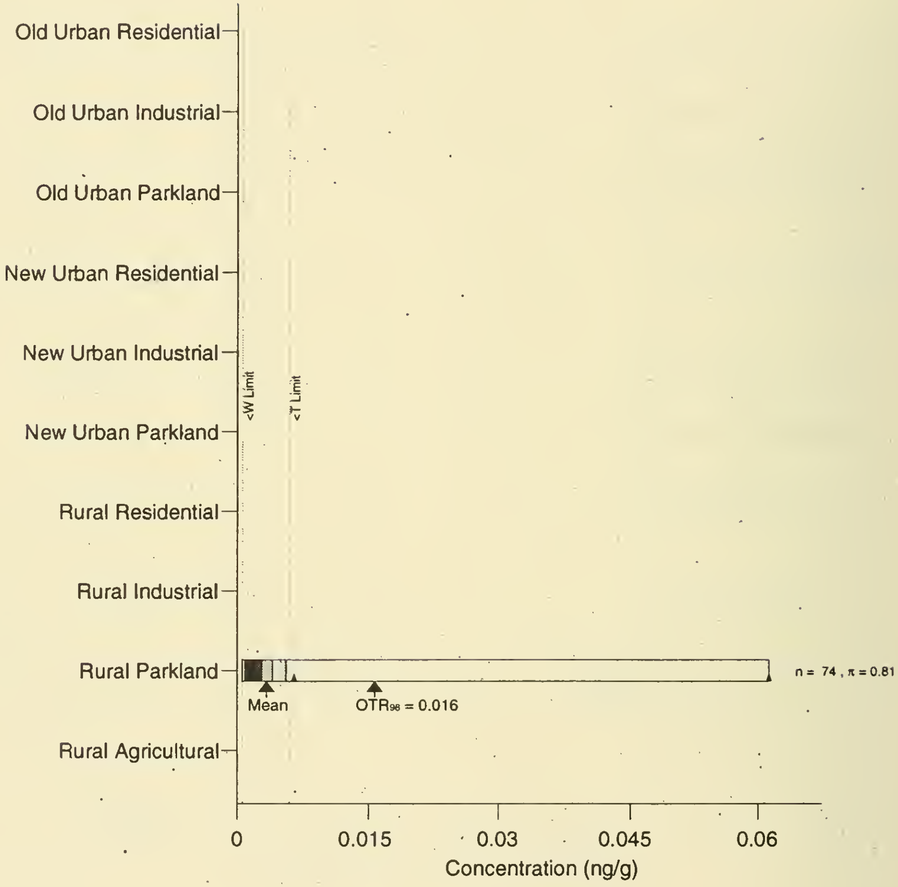


Figure 6.1.172

Ontario Typical Range

Hexachlorodibenzo-p-dioxins in Class 1 Soils

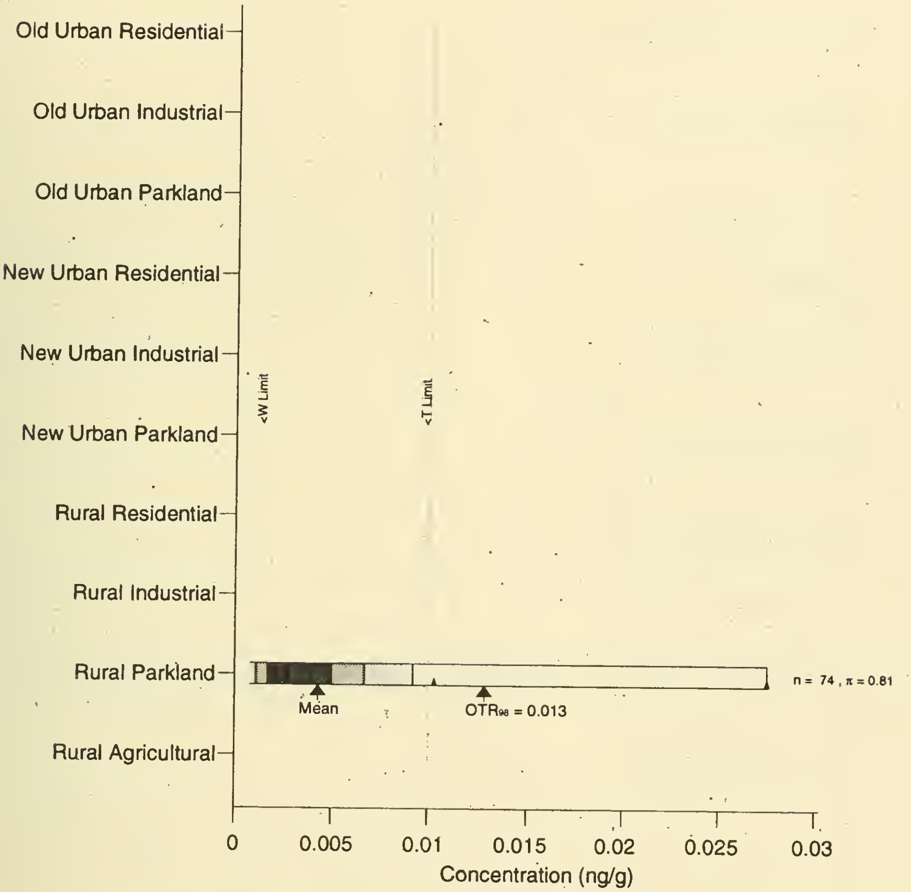


Figure 6.1.173

Ontario Typical Range

Heptachlorodibenzo-p-dioxins in Class 1 Soils

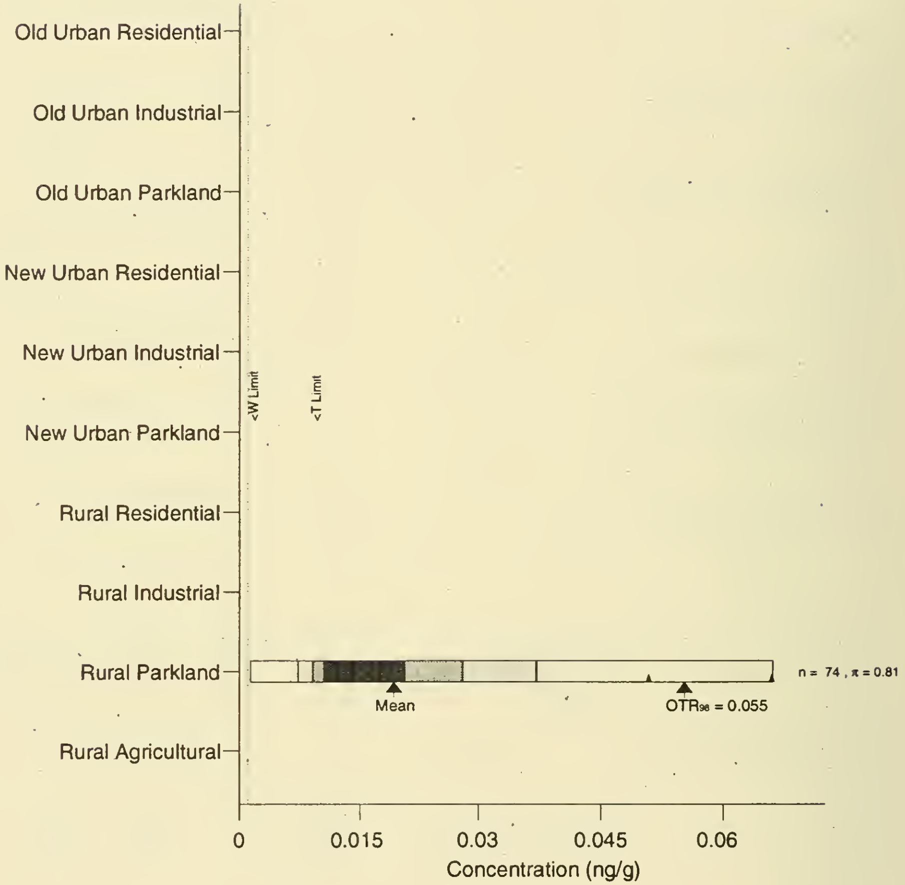


Figure 6.1.174

Ontario Typical Range

Octachlorodibenzo-p-dioxins in Class 1 Soils

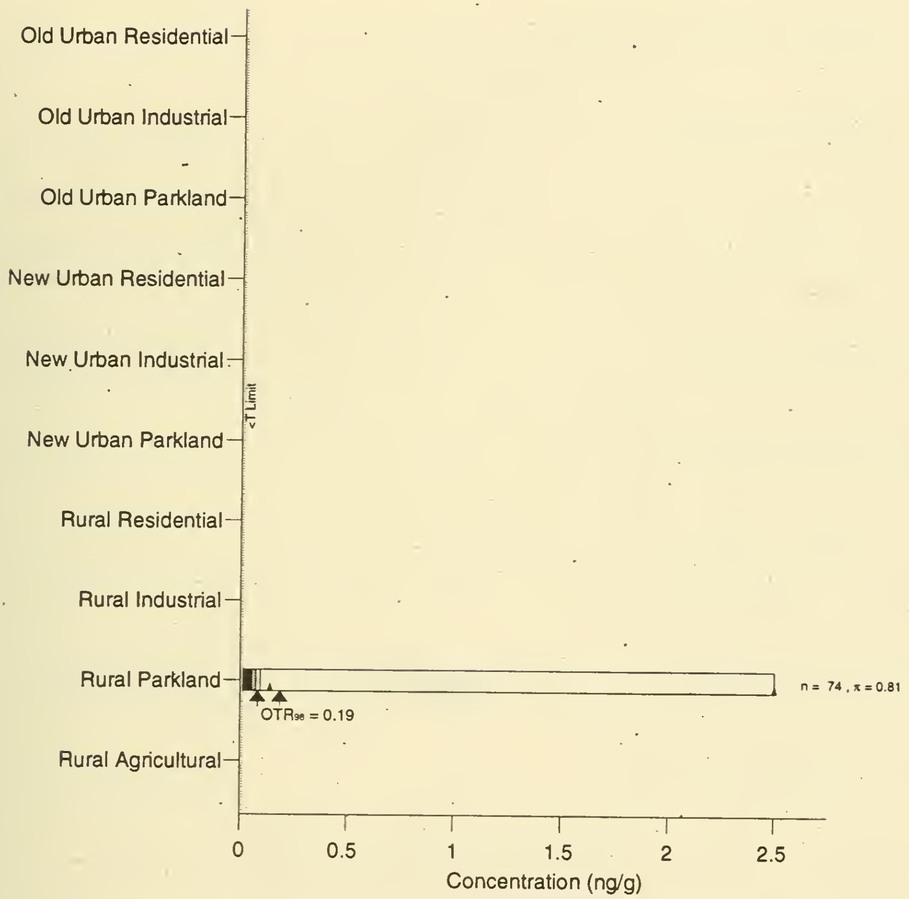


Figure 6.1.175

Ontario Typical Range

2,3,7,8 Tetrachloro-p-dioxin in Class 1 Soils

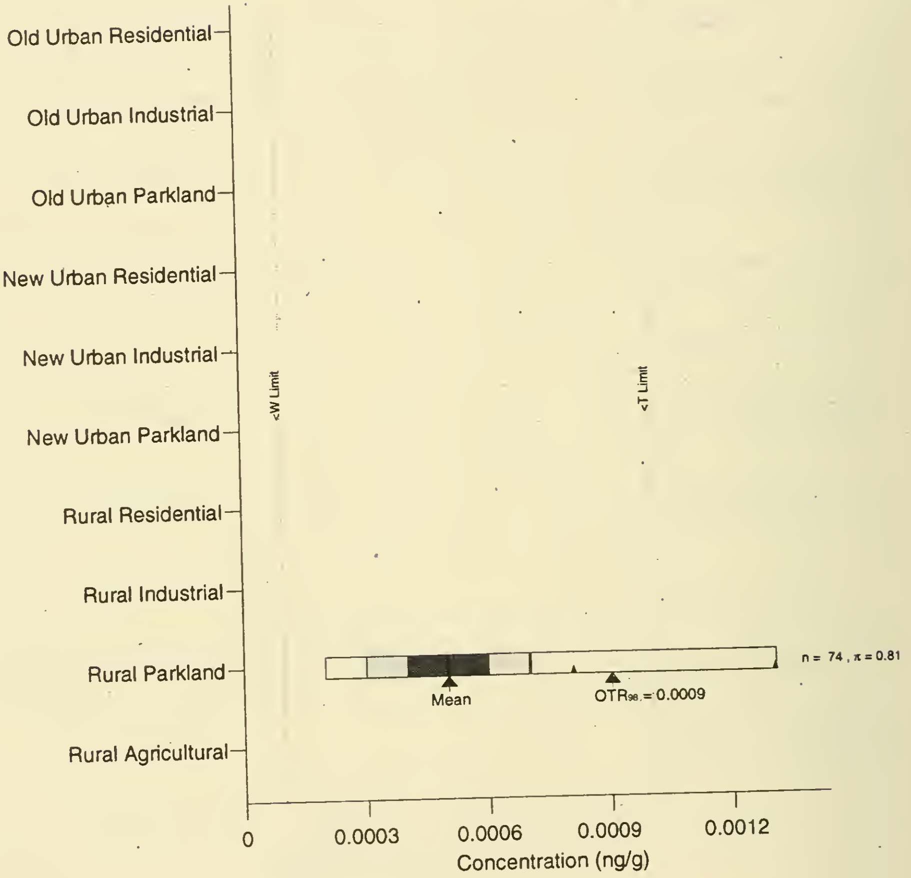
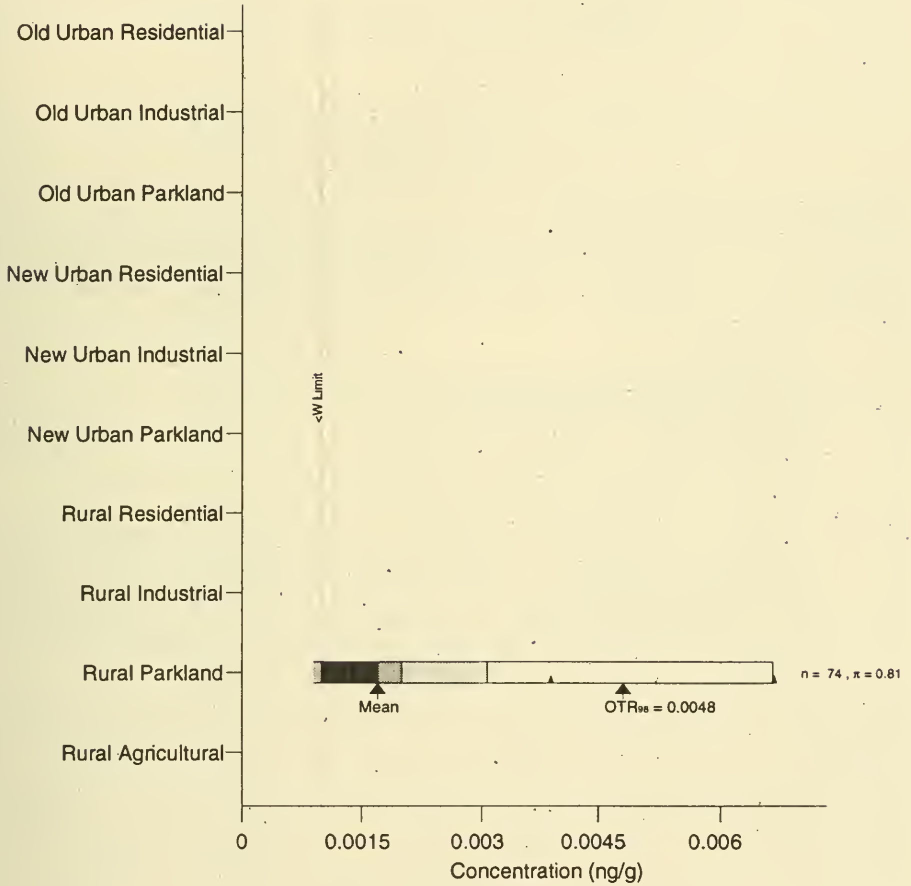


Figure 6.1.176

Ontario Typical Range

2,3,7,8-TCCD Toxic Equivalents in Class 1 Soils



6.2 OTR's for Vegetation

As of this revision of the OTR document there are no OTR data for vegetation.

6.3 OTR's for Mossbags

As of this revision of the OTR document there are no OTR data for mossbags.

6.4 OTR's for Snow

As of this revision of the OTR document there are no OTR data for snow.

Section 7 Summary of OTR_{98}s

The following tables are summaries of the OTR graphs in Section 6. Each table is for one receptor, test parameter group combination (ie. inorganics in soil). For each of these combinations the following information is presented:

- **OTR98** value.
- Lower Confidence Limit (**LCL**) for the OTR_{98}.
- Upper Confidence Limit (**UCL**) for the OTR_{98}.
- Confidence Level (π) for the confidence limits.
- Number of data points (**n**) used in the OTR distribution.
- Average within site sampling variability ($\bar{x}$**CV**) around the OTR_{98}, expressed as a percent coefficient of variability (CV). This is calculated by taking the average of the within site CV's of all the points between the OTR_{98} upper and lower confidence limits.
- Average number of samples ($\bar{x}\mathbf{n}_{CV}$) used for each data point (ie number of samples per site) between the OTR_{98} upper and lower confidence limits.

The last two parameters are included as there can be very large within site sampling variability or sampling error for some organic test parameters. While most of the inorganic test parameters have very low CV's, 10% or less, around the OTR_{98}, some of the organic test parameters can have very large CV's, up to 100%, around the OTR_{98}. These large CV's should be taken into consideration whenever sample data for these test parameters are compared against their OTR_{98} values.

These summary tables are generated manually from the summary printouts of the OTR Generation and Graphics program. If discrepancies are found between the values in these tables and the corresponding *graphics in Section 6, the graphics values are to be taken as the correct values.*

Table 7.1.a: Summary of OTR_{98} Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Aluminum (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	27000	24000	28000	0.76	60	4%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	30000	28000	36000	0.91	101	12%	3
	Agricultural	-						
Antimony (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.43	0.38	0.53	0.76	60	45%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.43	0.43	0.47	0.91	101	52%	3
	Agricultural	-						
Arsenic (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	17	12	61	0.76	60	31%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	11	8.6	30	0.91	101	15%	3
	Agricultural	-						
Barium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	180	130	300	0.76	60	9%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	160	150	210	0.91	101	10%	3
	Agricultural	-						
Beryllium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.97	0.87	1.1	0.76	60	6%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	1.1	0.93	1.2	0.91	101	5%	3
	Agricultural	-						

"-" - no OTR has been developed at this time.

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR_{98} Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}CV$	$\bar{x}n_{CV}$
Boron (μg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	30	25	62	0.76	60	9%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	30	26	48	0.76	60	11%	3
	Agricultural	-						
Cadmium (μg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.84	0.53	1.1	0.76	60	7%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.71	0.57	1.0	0.91	101	10%	3
	Agricultural	-						
Calcium (μg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	58000	44000	110000	0.76	60	6%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	55000	36000	64000	0.91	101	7%	3
	Agricultural	-						
Chloride (μg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	220	66	410	0.76	60	24%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	45	29	58	0.91	101	14%	3
	Agricultural	-						
Chromium (μg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	62	46	83	0.76	60	7%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	58	53	79	0.91	101	8%	3
	Agricultural	-						

"-" - no OTR has been developed at this time.
If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR_{98} Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use		OTR_{98}	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Chromium VI (µg/g)	Old Urban:	Parkland	0.5<W[P]	0.25	0.33	0.76	60	9%	3
	Rural:	Parkland	0.5<W[P]	0.25	0.92	0.91	101	16%	3
Cobalt (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	17	15	19	0.76	60	11%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	16	14	19	0.91	101	10%	3
		Agricultural	-						
Copper (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	65	39	375	0.76	60	15%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	41	36	87	0.91	101	18%	3
		Agricultural	-						
Cyanide (free) (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	0.02	0.01	0.38	0.76	60	62%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland[5]	0.051	0.008	0.090	0.88	85	68%	3
		Parkland[12346]	0.040	0.027	0.042	0.33	17	104%	3
		Agricultural							
Fluoride (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	42	38	45	0.76	60	23%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	61	35	140	0.91	101	15%	3
		Agricultural	-						

"-" - no OTR has been developed at this time. [1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

[P] - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR$_{98}$ Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use		OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}$n$_{CV}$
Iron (μg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	33000	31000	36000	0.76	60	6%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	35000	32000	38000	0.96	101	4%	3
		Agricultural	-						
Lead (μg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	98	57	110	0.76	60	9%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	45	35	74	0.76	60	11%	3
		Agricultural	-						
Magnesium (μg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	16000	14000	23000	0.76	60	5%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	20000	15000	36000	0.91	101	4%	3
		Agricultural	-						
Manganese (μg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	1300	970	3000	0.76	60	16%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland[5,6]	2200	1800	4700	0.79	68	24%	3
		Parkland[1,2,3,4]	1300	1000	1600	0.52	33	14%	3
		Agricultural							
Mercury (μg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	0.18	0.12	0.29	0.76	60	15%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	0.13	0.12	0.24	0.91	101	10%	3
		Agricultural	-						

"-" - no OTR has been developed at this time. [1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR_{98} Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use		OTR_{98}	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Molybdenum (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	0.85	0.77	2.2	0.76	60	20%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	1.0	0.60	4.4	0.91	101	11%	3
		Agricultural	-						
Nickel (µg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	32	25	35	0.76	60	7%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	38	27	56	0.91	101	7%	3
		Agricultural	-						
Nitrate+Nitrite (mg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	0.044	0.024	0.063	0.76	60	19%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland[2]	0.027	0.020	0.048	0.88	84	13%	3
		Parkland[13456]	0.030	0.026	0.031	0.34	17	17%	3
		Agricultural	-						
Total Nitrogen (mg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	6.6	4.3	17	0.76	60	5%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland	5.7	4.2	6.3	0.91	101	15%	3
		Agricultural	-						
Total Phosphorus (mg/g)	Old Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	1.2	1.1	1.4	0.76	60	5%	3
	New Urban:	Residential	-						
		Ind/Com/RW	-						
		Parkland	-						
	Rural:	Residential	-						
		Ind/Com/RW	-						
		Parkland[234]	0.90	0.84	0.98	0.71	50	17%	3
		Parkland[156]	1.9	1.3	2.2	0.72	51	9%	3
		Agricultural	-						

"-" - no OTR has been developed at this time. [1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region *If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.*

Table 7.1.a: Summary of OTR$_{98}$ Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Total Potassium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	5000	4500	6800	0.76	60	7%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	6500	5600	9100	0.91	101	9%	3
	Agricultural	-						
Selenium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	1.3	0.83	1.7	0.76	60	21%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.93	0.67	2.0	0.91	101	24%	3
	Agricultural	-						
Silver (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.33	0.23	0.40	0.76	60	13%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland[6]	0.27	0.22	0.31	0.88	84	15%	3
	Parkland[1,2,3,4,5]	0.11	0.065	0.13	0.34	17	20%	3
	Agricultural							
Sodium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	910	470	1200	0.76	60	6%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	660	470	1600	0.91	101	12%	3
	Agricultural	-						
Strontium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	78	59	125	0.76	60	5%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	64	47	145	0.91	101	14%	3
	Agricultural	-						

"-" - no OTR has been developed at this time. [1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR_{98} Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}CV$	$\bar{x}n_{CV}$
Sulphur (%)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.097	0.082	0.11	0.76	60	6%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.079	0.074	0.094	0.91	101	9%	3
	Agricultural	-						
Thallium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.77	0.73	0.97	0.76	60	70%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	0.81	0.65	1.1	0.91	101	67%	3
	Agricultural	-						
Titanium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	4800	4100	6900	0.76	60	10%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	5200	4900	7300	0.91	101	6%	3
	Agricultural	-						
Uranium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	1.9	1.7	2.2	0.76	60	18%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland[6]	2.1	2.0	9.7	0.88	84	18%	3
	Parkland[1,2,3,4,5]	1.4	0.8	1.5	0.34	17	9%	3
	Agricultural	-						
Vanadium (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	71	55	91	0.76	60	8%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	77	67	110	0.91	101	9%	3
	Agricultural	-						

"-" - no OTR has been developed at this time. [1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.a: Summary of OTR$_{98}$ Values for Inorganics in Class 1 Soils (continued)

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Zinc (µg/g)	Old Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	140	120	140	0.76	60	7%	3
	New Urban: Residential	-						
	Ind/Com/RW	-						
	Parkland	-						
	Rural: Residential	-						
	Ind/Com/RW	-						
	Parkland	120	120	240	0.91	101	11%	3
	Agricultural	-						
SAR	Old Urban: Parkland	1.5	0.75	7.9	0.76	60	29%	3
	Rural: Parkland	0.71	0.56	1.34	0.91	101	22%	3
pH	Old Urban: Parkland	7.5	7.3	7.6	0.71	60	2%	3
	Rural: Parkland	7.4	7.2	7.7	0.91	101	1%	3
Conductivity (µMHO/cm)	Old Urban: Parkland	570	420	1100	0.76	60	14%	3
	Rural: Parkland	360	320	410	0.91	101	15%	3

"-" - no OTR has been developed at this time.

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.b: Summary of OTR_{98} Values for Monocyclic Aromatics Class 1 Soils

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}CV$	$\bar{x}n_{CV}$
Benzene (ng/g)	Old Urban: Parkland	0.047	0.039	0.052	0.76	59	76%	3
	Rural: Parkland^{56}	0.040	0.027	0.064	0.79	68	61%	3
	Parkland^{1234}	0.065	0.062	0.067	0.52	34	17%	3
Ethylbenzene (ng/g)	Old Urban: Parkland	0.40	0.30	0.44	0.76	59	31%	3
	Rural: Parkland^{6}	0.46	0.39	0.52	0.88	85	52%	3
	Parkland^{12345}	0.50	0.36	0.50	0.34	17	47%	3
Styrene (ng/g)	Old Urban: Parkland	0.003	0.0015	0.0067	0.76	59	36%	3
	Rural: Parkland	0.0062	0.0020	0.19	0.91	102	57%	3
Toluene (ng/g)	Old Urban: Parkland	0.92	0.66	0.95	0.76	59	57%	3
	Rural: Parkland	1.3	1.1	1.4	0.91	102	25%	3
o-Xylene (ng/g)	Old Urban: Parkland	0.36	0.25	0.46	0.76	59	43%	3
	Rural: Parkland	0.44	0.35	0.45	0.91	102	50%	3
m/p-Xylene (ng/g)	Old Urban: Parkland	0.42	0.32	0.78	0.76	59	49%	3
	Rural: Parkland	0.49	0.40	0.56	0.91	102	52%	3
Xylene (ng/g)	Old Urban: Parkland	0.80	0.64	1.1	0.76	59	46%	3
	Rural: Parkland	0.92	0.75	1.0	0.91	102	47%	3

^{1} - excluding SW Region, ^{2} - excluding WC Region, ^{3} - excluding Central Region, ^{4} - excluding SE Region, ^{5} - excluding NE Region, ^{6} - excluding NW Region

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.c: Summary of OTR$_{98}$ Values for PAHs Class 1 Soils

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}$n$_{CV}$
Acenaphthylene (ng/g)	Old Urban: Parkland	96^{P*}	33	334	0.76	60	83%	3
	Rural: Parkland[6]	30	22	50	0.88	84	74%	3
	Parkland[1,2,3,4,5]	93	58	110	0.34	17	74%	3
Acenaphthene (ng/g)	Old Urban: Parkland	160^{P*}	12	691	0.76	60	122%	3
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
5-Nitro acenaphthene (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	19	0.76	60	29%	3
	Rural: Parkland	6<W^{P}	6<W	8.8	0.91	101	16%	3
Anthracene (ng/g)	Old Urban: Parkland	230^{P*}	59	2200	0.76	60	98%	3
	Rural: Parkland	6<W^{P}	6<W	73	0.91	101	21%	3
Benzo(a) anthracene (ng/g)	Old Urban: Parkland	690^{P*}	310	2800	0.76	60	91%	3
	Rural: Parkland	49	30	390	0.91	101	47%	3
Dibenzo(a,h)-anthracene (ng/g)	Old Urban: Parkland	360^{P*}	140	630	0.76	60	120%	3
	Rural: Parkland	52	7	110	0.91	101	87%	3
Camphene (ng/g)	Old Urban: Parkland	54^{P*}	41	137	0.76	60	69%	3
	Rural: Parkland	31	13	139	0.91	101	113%	3
Chrysene (ng/g)	Old Urban: Parkland	940^{P*}	410	3000	0.76	60	97%	3
	Rural: Parkland	99	55	480	0.91	101	40%	3
Fluoranthene (ng/g)	Old Urban: Parkland	1600^{P*}	660	8300	0.76	60	94%	3
	Rural: Parkland	140	80	2000	0.91	101	37%	3
Fluorene (ng/g)	Old Urban: Parkland	140^{P*}	33	1100	0.71	60	113%	3
	Rural: Parkland	9.4^{P}	6<W	83	0.91	101	77%	3
Benzo(b) fluoranthene (ng/g)	Old Urban: Parkland	1600^{P*}	940	5000	0.76	60	97%	3
	Rural: Parkland	150	110	310	0.91	101	49%	3
Benzo(k) fluoranthene (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	6<W	0.76	60		
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
Indole (ng/g)	Old Urban: Parkland	30^{P*}	19	89	0.76	60	64%	3
	Rural: Parkland	100	48	130	0.91	101	90%	3
Napthalene (ng/g)	Old Urban: Parkland	90^{P*}	54	310	0.76	60	62%	3
	Rural: Parkland	6<W^{P}	6<W	9	0.91	101	48%	3

[1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

^{P} - Provisional OTR$_{98}$

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.c: Summary of OTR_{98} Values for PAHs Class 1 Soils (continued)

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
1-Chloronapthalene (ng/g)	Old Urban: Parkland	6<W[P]	6<W	6<W	0.76	60		
	Rural: Parkland	6<W[P]	6<W	380	0.91	101	31%	3
2-Chloronapthalene (ng/g)	Old Urban: Parkland	6<W[P]	6<W	19	0.76	60	29%	3
	Rural: Parkland	6<W[P]	6<W	14	0.91	101	19%	3
1-Methyl napthalene (ng/g)	Old Urban: Parkland	90[P*]	33	160	0.76	60	97%	3
	Rural: Parkland	6<W[P]	6<W	6<W	0.91	101		
2-Methyl napthalene (ng/g)	Old Urban: Parkland	110[P*]	26	200	0.76	60	80%	3
	Rural: Parkland	6<W[P]	6<W	9	0.91	101	16%	3
Perylene (ng/g)	Old Urban: Parkland	360[P*]	170	1000	0.76	60	128%	3
	Rural: Parkland	6<W[P]	6<W	48	0.91	101	24%	3
Benzo(ghi) perylene (ng/g)	Old Urban: Parkland	610[P*]	290	2000	0.71	60	75%	3
	Rural: Parkland	81	49	143	0.91	101	74%	3
Phenanthrene (ng/g)	Old Urban: Parkland	1400[P*]	400	10500	0.71	60	73%	3
	Rural: Parkland	92	43	1200	0.91	101	51%	3
Pyrene (ng/g)	Old Urban: Parkland	1200[P*]	490	6300	0.76	60	95%	3
	Rural: Parkland	110	54	1400	0.91	101	36%	3
Benzo(a)pyrene (ng/g)	Old Urban: Parkland	810[P*]	360	2400	0.76	60	108%	3
	Rural: Parkland	39	29	103	0.91	101	84%	3
Indeno(1,2,3-cd)-pyrene (ng/g)	Old Urban: Parkland	460[P*]	200	1800	0.76	60	69%	3
	Rural: Parkland	54	33	110	0.91	101	49%	3

[P] - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

[P*] - ***Because of concerns about possible localized contamination by PAH at some of the Old Urban Parkland sites, all of the Old Urban Parkland OTRs for PAH are being designated as Provisional at this time. The suspect sites will be resampled in the summer of 1994 to determine if there is abnormal PAH contamination. The OTRs will be recalculated and the Provisional status will be removed by the spring of 1995.***

Table 7.1.d: Summary of OTR$_{98}$ Values for Halogenated Cyclics Class 1 Soils

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Chlorobenzene (ng/g)	Old Urban: Parkland	0.063	0.046	0.076	0.76	60	40%	3
	Rural: Parkland[6]	0.035	0.018	0.060	0.88	85	48%	3
	Parkland[12345]	0.081	0.060	0.089	0.34	17	46%	3
1,2-Dichlorobenzene (ng/g)	Old Urban: Parkland	0.003<W^P	0.003<W	0.004	0.76	60	30%	3
	Rural: Parkland	0.003<W^P	0.003<W	0.003	0.91	101	6%	3
1,3-Dichlorobenzene (ng/g)	Old Urban: Parkland	0.003<W^P	0,003<W	0.0067	0.76	60	36%	3
	Rural: Parkland	0.003<W^P	0.003<W	0.037	0.91	101	46%	3
1,4-Dichlorobenzene (ng/g)	Old Urban: Parkland[5]	0.029	0.019	0.089	0.70	49	42%	3
	Parkland[12346]	1.1	0.03	1.32	0.22	10	50%	3
	Rural: Parkland5	0.046	0.019	0.075	0.88	85	71%	3
	Parkland[12346]	0.72	0.38	1.0	0.34	17	47%	3

[1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

[P] - Provisional OTR$_{98}$

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.e: Summary of OTR$_{98}$ Values for Halogenated Aliphatics Class 1 Soils

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Bromomethane (ng/g)	Old Urban: Parkland	1.2	0.45	1.6	0.76	60	102%	3
	Rural: Parkland[1]	1.1	0.25	2.1	0.88	85	59%	3
	Parkland[23456]	1.0	0.72	1.3	0.34	17	71%	3
Dibromochloromethane (ng/g)	Old Urban: Parkland	0.23	0.66	0.25	0.76	60	54%	3
	Rural: Parkland	0.19	0.11	0.32	0.91	101	51%	3
Ethylene dibromide (ng/g)	Old Urban: Parkland	0.014	0.009	0.032	0.76	60	95%	3
	Rural: Parkland	0.032	0.012	0.39	0.91	101	96%	3
Tribromomethane (ng/g)	Old Urban: Parkland	0.16	0.036	0.24	0.76	60	90%	3
	Rural: Parkland[5]	0.021	0.0015	0.062	0.88	85	81%	3
	Parkland[12346]	0.27	0.20	0.37	0.34	17	81%	3
Chloromethane (ng/g)	Old Urban: Parkland	0.080<W[P]	0.080<W	0.080	0.76	60	9%	3
	Rural: Parkland	0.080<W[P]	0.080<W	0.080	0.91	101	6%	3
Dichloromethane (ng/g)	Old Urban: Parkland	1.0	0.47	3.3	0.76	60	69%	3
	Rural: Parkland[6]	0.45	0.34	2.6	0.88	85	42%	3
	Parkland[12345]	0.73	0.56	0.80	0.34	17		3
Trichloromethane (ng/g)	Old Urban: Parkland	2.7	1.6	4.5	0.76	60	27%	3
	Rural: Parkland	2.2	0.66	7.4	0.91	101	76%	3
Trichlorofluoromethane (ng/g)	Old Urban: Parkland	13	12	15	0.76	60	48%	3
	Rural: Parkland[6]	8.3	5.0	35	0.88	85	27%	3
	Parkland[12345]	12	8.6	12	0.34	17		3
Carbon tetrachloride (ng/g)	Old Urban: Parkland	0.15	0.034	0.18	0.76	60	54%	3
	Rural: Parkland	0.15	0.050	0.41	0.91	101	48%	3
1,1-Dichloroethane (ng/g)	Old Urban: Parkland	0.002<W[P]	0.002<W	0.050	0.76	60	32%	3
	Rural: Parkland	0.0021[P]	0.002<W	0.017	0.91	101	54%	3
1,2-Dichloroethane (ng/g)	Old Urban: Parkland	0.015	0.0093	0.059	0.76	60	97%	3
	Rural: Parkland	0.075	0.021	0.18	0.91	101	34%	3
1,1,2-Trichloroethane (ng/g)	Old Urban: Parkland	0.022	0.008	0.034	0.76	60	77%	3
	Rural: Parkland	0.037	0.023	0.073	0.91	101	28%	3
1,1,1-Trichloroethane (ng/g)	Old Urban: Parkland[16]	0.80	0.41	1.5	0.62	40	55%	3
	Parkland[2345]	4.7	3.9	5.4	0.37	19	43%	3
	Rural: Parkland[6]	1.0	0.64	1.8	0.88	85	41%	3
	Parkland[12345]	5.0	3.9	5.3	0.37	17	31%	3

[1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

[P] - Provisional OTR$_{98}$

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.e: Summary of OTR_{98} Values for Halogenated Aliphatics Class 1 Soils (continued)

Parameter	**Land Use**	**OTR_{98}**	**LCL**	**UCL**	**π**	**n**	**$\bar{x}$CV**	**$\bar{x}n_{CV}$**
1,1,2,2-Tetrachloroethane (ng/g)	Old Urban: Parkland	$0.005<W^{P}$	0.005<W	0.005<W	0.76	60		
	Rural: Parkland	$0.005<W^{P}$	0.005<W	0.005<W	0.91	101		
Chloroethylene (ng/g)	Old Urban: Parkland	$0.03<W^{P}$	0.03<W	0.030	0.76	60	9%	3
	Rural: Parkland	$0.03<W^{P}$	0.03<W	0.381	0.91	101	18%	3
1,1-Dichloroethylene (ng/g)	Old Urban: Parkland	0.074	0.039	0.12	0.76	60	34%	3
					0.88			
	Rural: Parkland[6]	0.016	0.010	0.024	0.34	84	77%	3
	Parkland[12345]	0.097	0.063	0.098		17	16%	3
trans-1,2-Dichloroethylene (ng/g)	Old Urban: Parkland	0.0054^{P}	0.003<W	0.011	0.76	60	43%	3
	Rural: Parkland	$0.003<W^{P}$	0.003<W	0.018	0.91	101	27%	3
Trichloroethylene (ng/g)	Old Urban: Parkland	0.63	0.030	1.4	0.76	60	53%	3
	Rural: Parkland[5]	0.028	0.021	0.042	0.88	85	115%	3
	Parkland[12346]	3.2	0.72	4.0	0.34	17	39%	3
Tetrachloroethylene (ng/g)	Old Urban: Parkland	0.87	0.75	2.5	0.76	60	54%	3
	Rural: Parkland	1.1	0.79	3.7	0.91	101	32%	3
1,2-Dichloropropane (ng/g)	Old Urban: Parkland	0.0052^{P}	0.003<W	0.0087	0.76	60	86%	3
	Rural: Parkland	$0.003<W^{P}$	0.003<W	0.0073	0.91	101	44%	3
cis-1,3-Dichloropropene (ng/g)	Old Urban: Parkland	$0.003<W^{P}$	0.003<W	0.003	0.76	60	9%	3
	Rural: Parkland	$0.003<W^{P}$	0.003<W	0.003	0.91	101	6%	3
trans-1,3-Dichloropropene (ng/g)	Old Urban: Parkland	$0.003<W^{P}$	0.003<W	0.003	0.76	60	9%	3
	Rural: Parkland	$0.003<W^{P}$	0.003<W	0.003	0.91	101	6%	3

[1] - excluding SW Region, [2] - excluding WC Region, [3] - excluding Central Region, [4] - excluding SE Region, [5] - excluding NE Region, [6] - excluding NW Region

^{P} - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.f: Summary of OTR$_{98}$ Values for Phenolics in Class 1 Soils

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
m-Cresol (ng/g)	Old Urban: Parkland	26<W^{P}	26<W	68	0.76	60	28%	3
	Rural: Parkland	26<W^{P}	26<W	26<W	0.91	101		
o-Cresol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	25	0.76	60	25%	3
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
p-Cresol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
4,6-Dinitro -o-cresol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
Phenol (ng/g)	Old Urban: Parkland	27	1	40	0.76	60	113%	3
	Rural: Parkland	14<W^{P}	14<W	28	0.91	101	34%	3
2-Chlorophenol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
2,4-Dichlorophenol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	21	0.76	60	23%	3
	Rural: Parkland	14<W^{P}	14<W	32	0.91	101	10%	3
2,6-Dichlorophenol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
2,3,4-Trichlorophenol (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	6<W	0.76	60		
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
2,3,5-Trichlorophenol (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	6<W	0.76	60		
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
2,4,5-Trichlorophenol (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	6<W	0.76	60		
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
2,4,6-Trichlorophenol (ng/g)	Old Urban: Parkland	6<W^{P}	6<W	6<W	0.76	60		
	Rural: Parkland	6<W^{P}	6<W	6<W	0.91	101		
2,3,4,5-Tetrachlorophenol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		
2,3,4,6-Tetrachlorophenol (ng/g)	Old Urban: Parkland	14<W^{P}	14<W	14<W	0.76	60		
	Rural: Parkland	14<W^{P}	14<W	14<W	0.91	101		

^{P} - Provisional OTR$_{98}$

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.f: Summary of OTR_{98} Values for Phenolics in Class 1 Soils (continued)

Parameter	Land Use	OTR_{98}	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}\mathbf{n}_{CV}$
2,3,5,6-Tetrachlorophenol (ng/g)	Old Urban: Parkland	$14<W^P$	$14<W$	$14<W$	0.76	60		
	Rural: Parkland	$14<W^P$	$14<W$	$14<W$	0.91	101		
Pentachlorophenol (ng/g)	Old Urban: Parkland	$14<W^P$	$14<W$	$14<W$	0.76	60		
	Rural: Parkland	$14<W^P$	$14<W$	21	0.91	101	23%	3
4-Chloro-3-methylphenol (ng/g)	Old Urban: Parkland	$14<W^P$	$14<W$	$14<W$	0.76	60		
	Rural: Parkland	$14<W^P$	$14<W$	$14<W$	0.91	101		
2,4-Dimethylphenol (ng/g)	Old Urban: Parkland	$25<W^P$	$25<W$	$25<W$	0.76	60		
	Rural: Parkland	$25<W^P$	$25<W$	$25<W$	0.91	101		
4-Nitrophenol (ng/g)	Old Urban: Parkland	$32<W^P$	$32<W$	28	0.76	60	15%	3
	Rural: Parkland	$32<W^P$	$32<W$	53	0.91	101	23%	3
2,4-Dinitrophenol (ng/g)	Old Urban: Parkland	$16<W^P$	$16<W$	$16<W$	0.76	60		
	Rural: Parkland	$16<W^P$	$16<W$	$16<W$	0.91	101		

^{P} - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.g: Summary of OTR$_{98}$ Values for Pesticides in Class 1 Soils

Parameter	Land Use	OTR$_{98}$	LCL	UCL	π	n	$\bar{x}$CV	$\bar{x}n_{CV}$
Aldrin (ng/g)	Old Urban: Parkland	$1<W^P$	1<W	1<W	0.76	60		
	Rural: Parkland	$1<W^P$	1<W	1<W	0.91	101		
Carbaryl (ng/g)	Old Urban: Parkland	$16<W^P$	16<W	16<W	0.76	60		
	Rural: Parkland	$16<W^P$	16<W	16<W	0.91	101		
a-Chlordane (ng/g)	Old Urban: Parkland	$2<W^P$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^P$	2<W	9.3	0.91	101	22%	3
g-Chlordane (ng/g)	Old Urban: Parkland	$2<W^P$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^P$	2<W	2<W	0.91	101		
O,P-DDT (ng/g)	Old Urban: Parkland	168	16	340	0.76	60	48%	3
	Rural: Parkland	5.4^P	5<W	290	0.91	101	25%	3
P,P-DDT (ng/g)	Old Urban: Parkland	1300	240	2800	0.76	60	19%	3
	Rural: Parkland	75	24	4800	0.91	101	30%	3
DDT (ng/g)	Old Urban: Parkland	1400	250	3100	0.76	60	19%	3
	Rural: Parkland	78	27	5100	0.91	101	29%	3
2,4-D (ng/g)	Old Urban: Parkland	$100<W^P$	100<W	100<W	0.76	60		
	Rural: Parkland	$100<W^P$	100<W	100<W	0.91	101		
Diazinon (ng/g)	Old Urban: Parkland	$5<W^P$	5<W	5<W	0.76	60		
	Rural: Parkland	$5<W^P$	5<W	5<W	0.91	101		
Dieldrin (ng/g)	Old Urban: Parkland	$4<W^P$	4<W	4<W	0.76	60		
	Rural: Parkland	$4<W^P$	4<W	128	0.91	101	20%	3
Endrin (ng/g)	Old Urban: Parkland	$4<W^P$	4<W	4<W	0.76	60		
	Rural: Parkland	$4<W^P$	4<W	4<W	0.91	101		
Heptachlor (ng/g)	Old Urban: Parkland	$1<W^P$	1<W	1<W	0.76	60		
	Rural: Parkland	$1<W^P$	1<W	1<W	0.91	101		
Heptachlor epoxide (ng/g)	Old Urban: Parkland	$1<W^P$	1<W	1<W	0.76	60		
	Rural: Parkland	$1<W^P$	1<W	2.8	0.91	101	14%	3
Lindane (ng/g)	Old Urban: Parkland	$1<W^P$	1<W	1<W	0.76	60		
	Rural: Parkland	$1<W^P$	1<W	1<W	0.91	101		
Methoxychlor (ng/g)	Old Urban: Parkland	$5<W^P$	5<W	5<W	0.76	60		
	Rural: Parkland	$5<W^P$	5<W	5<W	0.91	101		

^{P} - Provisional OTR$_{98}$

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.g: Summary of OTR_{98} Values for Pesticides in Class 1 Soils (continued)

Parameter	**Land Use**	**OTR_{98}**	**LCL**	**UCL**	**π**	**n**	**$\bar{x}$CV**	**$\bar{x}n_{CV}$**
Methyl Parathion (ng/g)	Old Urban: Parkland	$4<W^P$	$4<W$	$4<W$	0.76	60		
	Rural: Parkland	$4<W^P$	$4<W$	$4<W$	0.91	101		
Parathion (ng/g)	Old Urban: Parkland	$4<W^P$	$4<W$	$4<W$	0.76	60		
	Rural: Parkland	$4<W^P$	$4<W$	$4<W$	0.91	101		
Silvex (ng/g)	Old Urban: Parkland	$50<W^P$	$50<W$	$50<W$	0.76	60		
	Rural: Parkland	$50<W^P$	$50<W$	$50<W$	0.91	101		
Toxaphene (ng/g)	Old Urban: Parkland	$335<W^P$	$335<W$	$335<W$	0.76	60		
	Rural: Parkland	$335<W^P$	$335<W$	$335<W$	0.91	101		

^{P} - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.h: Summary of OTR_{98} Values for PCBs in Class 1 Soils

Parameter	**Land Use**	**OTR_{98}**	**LCL**	**UCL**	**π**	**n**	**$\bar{x}CV$**	**$\bar{x}n_{CV}$**
Monochlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Dichlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Trichlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Tetrachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Pentachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Hexachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Heptachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Octachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Nonachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Decachlorinated biphenyls (ng/g)	Old Urban: Parkland	$2<W^{P}$	2<W	2<W	0.76	60		
	Rural: Parkland	$2<W^{P}$	2<W	2<W	0.91	101		
Total PCB's (ng/g)	Old Urban: Parkland	32	15	230	0.76	60	68%	3
	Rural: Parkland	15^{P}	6<W	64	0.91	101	45%	3

^{P} - Provisional OTR_{98}

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Table 7.1.i: Summary of OTR$_{98}$ Values for Dioxins/Furans in Class 1 Soils

Parameter	**Land Use**	**OTR$_{98}$**	**LCL**	**UCL**	π	**n**	$\bar{x}$**CV**	$\bar{x}$**n**$_{CV}$
Tetrachloro-dibenzofurans (ng/g)	Rural: Parkland	0.012	0.010	0.019	0.81	74	84%	2
Pentachloro-dibenzofurans (ng/g)	Rural: Parkland	0.019	0.010	0.031	0.81	74	70%	2
Hexachloro-dibenzofurans (ng/g)	Rural: Parkland	0.028	0.020	0.033	0.81	74	77%	2
Heptachloro-dibenzofurans (ng/g)	Rural: Parkland	0.032	0.024	0.055	0.81	74	40%	2
Octachloro-dibenzofurans (ng/g)	Rural: Parkland	0.028	0.015	0.37	0.81	74	48%	2
Tetrachloro-dibenzodioxins (ng/g)	Rural: Parkland	0.0066	0.0042	0.018	0.81	74	96%	2
Pentachloro-dibenzodioxins (ng/g)	Rural: Parkland	0.016	0.0065	0.061	0.81	74	38%	2
Hexachloro-dibenzodioxins (ng/g)	Rural: Parkland	0.013	0.010	0.028	0.81	74	40%	2
Heptachloro-dibenzodioxins (ng/g)	Rural: Parkland	0.055	0.051	0.066	0.81	74	24%	2
Octachloro-dibenzodioxins (ng/g)	Rural: Parkland	0.19	0.14	2.5	0.81	74	28%	2
2,3,7,8-Tetrachloro-p-dioxin (ng/g)	Rural: Parkland	0.0009<	0.0008<	0.0013<	0.81	74	65%	2
2,3,7,8-TCCD Toxic Equivalents (ng/g)	Rural: Parkland	0.0048	0.0039	0.0067	0.81	74	23%	2

If discrepancies are found between the values in this tables and the corresponding graphics in Section 6, the graphics values are to be taken as the correct values.

Appendix A: OTR Model Statistics and Graphics

The two statistical procedures described below will be used every time new data are added to the OTR database (the OTR database is a subset of the Phytotoxicology Section database). With the increasing size of the database this may mean that existing OTR's will be combined. Existing OTR's may also be split into multiple OTR's due to differences between species within a group or differences between Regions.

Appendix A1: Distribution-Free Confidence Intervals for Quantiles

Normally for parametric statistics, the confidence limits are calculated based on the level of confidence in the limits, such as 95%, that is desired. In this method, arbitrary confidence limits are chosen, x quantiles to the right and left of the quantile of interest, and the confidence level or probability the quantile of interest falls between the chosen limits is then calculated.

The following description of determining Distribution-Free Confidence Intervals for Quantiles is adapted from David(10). A continuous variate X with a strictly increasing cumulative distribution function $P(x) = p$ for $0 < p < 1$ has a unique solution, $x = \varepsilon_p$, which is called the (population) *quantile of order p*. For the purposes of the OTR Guidelines $\varepsilon_{0.975}$ is the OTR_{98}. In the continuous case, the lower and upper confidence limits $(X_{(r)}, X_{(s)})$, covers ε_p with probability $\pi(r,s,n,p)$ given by :

$$\pi(r,s,n,p) = \sum_{i=r}^{s-1} \binom{n}{r} p^{i} (1-p)^{n-i}$$

r is the data point of the lower confidence limit

s is the data of the upper confidence limit

n is the number of observations in the distribution

p is the *quantile of order p*, $p = 0.975$

$\binom{n}{r}$ is the binomial coefficient where $\binom{n}{r} = \frac{n!}{r!(n-r)!} = \frac{n(n-1)(n-2)\ldots(n-r+1)}{r(r-1)(r-2)\ldots(2)(1)}$

The probability $\pi(r,s,n,p)$ depends on r, s, n and p but not on the type of distribution $P(x) = p$, thus allowing the construction of distribution-free confidence intervals for the OTR_{98}.

The data points for $\varepsilon_{0.975}$, $X_{(r)}$, $X_{(s)}$ and the probability $\pi(r,s,n,p)$ for any value of n from 20 to 379 are given in Table A1. These $X_{(r)}$ and $X_{(s)}$ values were chosen to give the largest probability, $\pi(r,s,n,p) \geq 90\%$ probability, while maintaining the tightest confidence interval that could be achieved for each value of n.

This was done by initially choosing one quantile on either side of the OTR_{98} quantile. The probability $\pi(r,s,n,p)$ was then calculated. If $\pi(r,s,n,p)$ was <90%, then the confidence limit quantile was increase by one at a time, always to the left first, and $\pi(r,s,n,p)$ recalculated. This was done until either the 90% confidence was reached or the upper confidence limit equaled n. The actual values of the data points $X_{(r)}$ and $X_{(s)}$ for a given OTR distribution are the upper and lower confidence limits, with $\pi(r,s,n,p)$ probability, for the OTR_{98}.

Table A1: Values of $\varepsilon_{0.975}$, $X_{(r)}$, $X_{(s)}$ and $\pi(r,s,n,p)$ppb for n between 20 and 379

n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π
20	19.5	18	20	0.38	60	58.5	56	60	0.76	100	97.5	94	100	0.91
21	20.5	19	21	0.40	61	59.5	57	61	0.77	101	98.5	95	101	0.91
22	21.5	20	22	0.41	62	60.5	58	62	0.77	102	99.5	96	102	0.91
23	22.4	21	23	0.42	63	61.4	59	63	0.78	103	100.4	97	103	0.91
24	23.4	22	24	0.43	64	62.4	60	64	0.78	104	101.4	98	104	0.91
25	24.4	23	25	0.45	65	63.4	61	65	0.78	105	102.4	99	105	0.91
26	25.4	24	26	0.46	66	64.4	62	66	0.79	106	103.4	100	106	0.91
27	26.3	25	27	0.47	67	65.3	63	67	0.79	107	104.3	101	107	0.92
28	27.3	26	28	0.48	68	66.3	64	68	0.79	108	105.3	102	108	0.92
29	28.3	27	29	0.48	69	67.3	65	69	0.80	109	106.3	103	109	0.92
30	29.3	28	30	0.49	70	68.3	66	70	0.80	110	107.3	104	110	0.92
31	30.2	29	31	0.50	71	69.2	67	71	0.80	111	108.2	105	111	0.92
32	31.2	30	32	0.51	72	70.2	68	72	0.80	112	109.2	106	112	0.92
33	32.2	31	33	0.52	73	71.2	69	73	0.81	113	110.2	107	113	0.92
34	33.2	32	34	0.52	74	72.2	70	74	0.81	114	111.2	108	114	0.92
35	34.1	33	35	0.53	75	73.1	71	75	0.81	115	112.1	109	115	0.92
36	35.1	34	36	0.54	76	74.1	72	76	0.81	116	113.1	110	116	0.92
37	36.1	35	37	0.54	77	75.1	73	77	0.81	117	114.1	111	117	0.92
38	37.1	36	38	0.55	78	76.1	74	78	0.82	118	115.1	112	118	0.92
39	38.0	36	39	0.61	79	77.0	74	79	0.85	119	116.0	113	119	0.92
40	39.0	37	40	0.62	80	78.0	75	80	0.85	120	117.0	114	120	0.92
41	40.0	38	41	0.63	81	79.0	76	81	0.86	121	118.0	115	121	0.92
42	41.0	39	42	0.63	82	80.0	77	82	0.86	122	119.0	116	122	0.92
43	41.9	39	43	0.66	83	80.9	77	83	0.87	123	119.9	116	123	0.94
44	42.9	40	44	0.67	84	81.9	78	84	0.88	124	120.9	117	124	0.94
45	43.9	41	45	0.67	85	82.9	79	85	0.88	125	121.9	118	125	0.94
46	44.9	42	46	0.68	86	83.9	80	86	0.88	126	122.9	119	126	0.94
47	45.8	43	47	0.69	87	84.8	81	87	0.88	127	123.8	120	127	0.94
48	46.8	44	48	0.70	88	85.8	82	88	0.89	128	124.8	121	128	0.95
49	47.8	45	49	0.70	89	86.8	83	89	0.89	129	125.8	122	129	0.95
50	48.8	46	50	0.71	90	87.8	84	90	0.89	130	126.8	123	130	0.95
51	49.7	47	51	0.72	91	88.7	85	91	0.89	131	127.7	124	131	0.95
52	50.7	48	52	0.72	92	89.7	86	92	0.89	132	128.7	125	132	0.95
53	51.7	49	53	0.73	93	90.7	87	93	0.90	133	129.7	126	133	0.95
54	52.7	50	54	0.73	94	91.7	88	94	0.90	134	130.7	127	134	0.95
55	53.6	51	55	0.74	95	92.6	89	95	0.90	135	131.6	128	135	0.95
56	54.6	52	56	0.74	96	93.6	90	96	0.90	136	132.6	129	136	0.95
57	55.6	53	57	0.75	97	94.6	91	97	0.90	137	133.6	130	137	0.95
58	56.6	54	58	0.75	98	95.6	92	98	0.90	138	134.6	131	138	0.95
59	57.5	55	59	0.76	99	96.5	93	99	0.91	139	135.5	132	139	0.95

$\varepsilon_{0.975}$ - the OTR_{98} quantile for sample size n.
$X_{(r)}$ - the lower confidence limit quantile for sample size n.
$X_{(s)}$ - the upper confidence limit quantile for sample size n
π - the probability the OTR_{98} falls between the confidence limits.

Table A1: Continued

n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π
140	136.5	133	140	0.95	180	175.5	172	179	0.90	220	214.5	210	219	0.95
141	137.5	134	141	0.95	181	176.5	173	180	0.90	221	215.5	211	220	0.95
142	138.5	135	142	0.95	182	177.5	174	181	0.90	222	216.5	212	221	0.95
143	139.4	136	143	0.95	183	178.4	175	182	0.90	223	217.4	213	222	0.95
144	140.4	137	144	0.94	184	179.4	176	183	0.90	224	218.4	214	223	0.95
145	141.4	138	145	0.94	185	180.4	177	184	0.90	225	219.4	215	224	0.95
146	142.4	139	146	0.94	186	181.4	178	185	0.90	226	220.4	216	225	0.95
147	143.3	140	147	0.94	187	182.3	179	186	0.90	227	221.3	217	226	0.95
148	144.3	141	148	0.94	188	183.3	180	187	0.90	228	222.3	218	227	0.95
149	145.3	142	149	0.94	189	184.3	181	188	0.90	229	223.3	219	228	0.95
150	146.3	143	150	0.94	190	185.3	182	189	0.90	230	224.3	220	229	0.95
151	147.2	144	151	0.94	191	186.2	183	190	0.90	231	225.2	221	230	0.95
152	148.2	145	152	0.94	192	187.2	184	191	0.90	232	226.2	222	231	0.95
153	149.2	146	153	0.94	193	188.2	185	192	0.90	233	227.2	223	232	0.95
154	150.2	147	154	0.94	194	189.2	185	193	0.93	234	228.2	224	233	0.95
155	151.1	148	155	0.94	195	190.1	186	194	0.93	235	229.1	225	234	0.95
156	152.1	149	156	0.94	196	191.1	187	195	0.93	236	230.1	226	235	0.95
157	153.1	150	157	0.94	197	192.1	188	196	0.93	237	231.1	227	236	0.94
158	154.1	151	158	0.94	198	193.1	189	197	0.93	238	232.1	228	237	0.94
159	155.0	151	159	0.96	199	194.0	190	198	0.93	239	233.0	228	237	0.92
160	156.0	152	160	0.96	200	195.0	191	199	0.93	240	234.0	229	238	0.92
161	157.0	153	161	0.96	201	196.0	192	200	0.93	241	235.0	230	239	0.92
162	158.0	154	162	0.96	202	197.0	193	201	0.93	242	236.0	231	240	0.92
163	158.9	154	162	0.91	203	197.9	193	202	0.95	243	236.9	232	241	0.92
164	159.9	155	163	0.91	204	198.9	194	203	0.95	244	237.9	233	242	0.92
165	160.9	156	164	0.91	205	199.9	195	204	0.95	245	238.9	234	243	0.92
166	161.9	157	165	0.91	206	200.9	196	205	0.95	246	239.9	235	244	0.92
167	162.8	158	166	0.91	207	201.8	197	206	0.95	247	240.8	236	245	0.92
168	163.8	159	167	0.91	208	202.8	198	207	0.95	248	241.8	237	246	0.93
169	164.8	160	168	0.92	209	203.8	199	208	0.95	249	242.8	238	247	0.93
170	165.8	161	169	0.92	210	204.8	200	209	0.95	250	243.8	239	248	0.93
171	166.7	163	170	0.90	211	205.7	201	210	0.95	251	244.7	240	249	0.93
172	167.7	164	171	0.90	212	206.7	202	211	0.95	252	245.7	241	250	0.93
173	168.7	165	172	0.90	213	207.7	203	212	0.95	253	246.7	242	251	0.93
174	169.7	166	173	0.90	214	208.7	204	213	0.95	254	247.7	243	252	0.93
175	170.6	167	174	0.90	215	209.6	205	214	0.95	255	248.6	244	253	0.93
176	171.6	168	175	0.90	216	210.6	206	215	0.95	256	249.6	245	254	0.93
177	172.6	169	176	0.90	217	211.6	207	216	0.95	257	250.6	246	255	0.93
178	173.6	170	177	0.90	218	212.6	208	217	0.95	258	251.6	247	256	0.93
179	174.5	171	178	0.90	219	213.5	209	218	0.95	259	252.5	248	257	0.93

$\varepsilon_{0.975}$ - the OTR_{98} quantile for sample size n.

$X_{(r)}$ - the lower confidence limit quantile for sample size n.

$X_{(s)}$ - the upper confidence limit quantile for sample size n

π - the probability the OTR_{98} falls between the confidence limits.

Table A1: Continued

n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π	n	$\varepsilon_{0.975}$	$X_{(r)}$	$X_{(s)}$	π
260	253.5	249	258	0.93	300	292.5	288	297	0.90	340	331.5	326	336	0.90
261	254.5	250	259	0.93	301	293.5	289	298	0.90	341	332.5	327	337	0.90
262	255.5	251	260	0.93	302	294.5	290	299	0.90	342	333.5	328	338	0.90
263	256.4	252	261	0.93	303	295.4	291	300	0.90	343	334.4	329	339	0.90
264	257.4	253	262	0.93	304	296.4	292	301	0.90	344	335.4	330	340	0.90
265	258.4	254	263	0.93	305	297.4	293	302	0.90	345	336.4	331	341	0.90
266	259.4	255	264	0.93	306	298.4	294	303	0.90	346	337.4	332	342	0.90
267	260.3	256	265	0.93	307	299.3	295	304	0.90	347	338.3	333	343	0.91
268	261.3	257	266	0.93	308	300.3	296	305	0.90	348	339.3	334	344	0.91
269	262.3	258	267	0.93	309	301.3	297	306	0.90	349	340.3	335	345	0.91
270	263.3	259	268	0.93	310	302.3	298	307	0.90	350	341.3	336	346	0.91
271	264.2	260	269	0.92	311	303.2	299	308	0.90	351	342.2	337	347	0.91
272	265.2	261	270	0.92	312	304.2	300	309	0.90	352	343.2	338	348	0.91
273	266.2	262	271	0.92	313	305.2	301	310	0.90	353	344.2	339	349	0.91
274	267.2	263	272	0.92	314	306.2	302	311	0.90	354	345.2	340	350	0.91
275	268.1	264	273	0.92	315	307.1	303	312	0.90	355	346.1	341	351	0.91
276	269.1	265	274	0.92	316	308.1	303	313	0.93	356	347.1	342	352	0.91
277	270.1	266	275	0.92	317	309.1	304	314	0.93	357	348.1	343	353	0.91
278	271.1	267	276	0.92	318	310.1	305	315	0.93	358	349.1	344	354	0.91
279	272.0	267	277	0.95	319	311.0	306	316	0.93	359	350.0	345	355	0.91
280	273.0	268	278	0.95	320	312.0	307	317	0.93	360	351.0	346	356	0.91
281	274.0	269	279	0.95	321	313.0	308	318	0.93	361	352.0	347	357	0.91
282	275.0	270	280	0.95	322	314.0	309	319	0.93	362	353.0	348	358	0.91
283	275.9	270	280	0.91	323	314.9	309	320	0.94	363	353.9	348	359	0.93
284	276.9	271	281	0.91	324	315.9	310	321	0.94	364	354.9	349	360	0.93
285	277.9	272	282	0.91	325	316.9	311	322	0.94	365	355.9	350	361	0.93
286	278.9	273	283	0.91	326	317.9	312	323	0.94	366	356.9	351	362	0.93
287	279.8	274	284	0.92	327	318.8	313	324	0.94	367	357.8	352	363	0.93
288	280.8	275	285	0.92	328	319.8	314	325	0.95	368	358.8	353	364	0.93
289	281.8	277	286	0.90	329	320.8	315	326	0.95	369	359.8	354	365	0.93
290	282.8	278	287	0.90	330	321.8	316	327	0.95	370	360.8	355	366	0.93
291	283.7	279	288	0.90	331	322.7	317	328	0.95	371	361.7	356	367	0.93
292	284.7	280	289	0.90	332	323.7	318	329	0.95	372	362.7	357	368	0.93
293	285.7	281	290	0.90	333	324.7	319	330	0.95	373	363.7	358	369	0.93
294	286.7	282	291	0.90	334	325.7	320	331	0.95	374	364.7	359	370	0.93
295	287.6	283	292	0.90	335	326.6	321	332	0.95	375	365.6	360	371	0.93
296	288.6	284	293	0.90	336	327.6	322	332	0.90	376	366.6	361	372	0.93
297	289.6	285	294	0.90	337	328.6	323	333	0.90	377	367.6	362	373	0.93
298	290.6	286	295	0.90	338	329.6	324	334	0.90	378	368.6	363	374	0.93
299	291.5	287	296	0.90	339	330.5	325	335	0.90	379	369.5	364	375	0.93

$\varepsilon_{0.975}$ - the OTR_{98} quantile for sample size n.

$X_{(r)}$ - the lower confidence limit quantile for sample size n.

$X_{(s)}$ - the upper confidence limit quantile for sample size n

π - the probability the OTR_{98} falls between the confidence limits.

Appendix A2: Kolmogorov-Smirnov Two Sample Test

The Kolmogorov-Smirnov Two Sample Test is a non parametric statistical test that determines whether two distributions have the same mean, standard deviation and shape. The following description of the Kolmogorov-Smirnov Two Sample Test is adapted from Steel and Torrie (9).

The Kolmogorov-Smirnov Two Sample Test calls for two independent samples and tests the null hypothesis that they come from identical distributions. For data points $Y_{11},...,Y_{1n_1}$ and $Y_{21},...,Y_{2n_2}$, then $H_0:F_1(Y)=F_2(Y)$ where F_i is the true, but unspecified, cumulative distribution function. The test compares the two data distribution functions looking at the maximum numerical difference between them.

The following procedure is used to conduct the test.

1. Rank all observations together.
2. Determine the sample cumulative distribution functions, $F_n(Y_1)$ and $F_n(Y_2)$.
3. Compute $|\, F_n(Y_1) - F_n(Y_2) \,|$ at each of the values of Y.
4. Find D as defined by:

$$D = maximum \ |\, F_n(Y) - F_0(Y) \,|$$

where D is essentially the largest value as determined by $|\, F_n(Y_1) - F_n(Y_2) \,|$.

5. Compare D with the critical value as approximated by the following equations.

$$\text{Critical Value} = \frac{1.7302}{\sqrt{n_1 + n_2}}$$

for $1 - \alpha = 0.95$ and $n_1 = n_2$

or

$$\text{Critical Value} = \sqrt{\frac{n_1 + n_2}{n_1 n_2}} \times 1.3581$$

for $1 - \alpha = 0.95$ and $n_1 \neq n_2$

note: The above approximations are meant for large sample sizes. However, for the purposes of the OTRs these approximations will be used down to combined samples sizes of 20.

6. If D is greater than the critical value, then the two samples are from different populations and separate OTR's will have to be developed if there is sufficient sample size. Conversely if D is less than the critical value, then the two samples may be combined into one OTR.

The Kolmogorov-Smirnov test will be applied in the OTR analysis in the following way:

a. For each parameter/receptor/land use combination, each OMOEE Region will be compared against every other Region for which there is sufficient data. If a Region fails against all other Regions or a group of Regions fails the Kolmogorov-Smirnov test against all the other Regions, then the Region or group of Regions will be a excluded from the OTR distribution. Separate OTR distributions will be created for excluded Regions or groups of Regions.

b. Once the OTR distribution is determined for each parameter/receptor/land use combination, then the OTR distribution for each land use category will be tested against all other land use categories. If two or more land use categories pass the Kolmogorov-Smirnov test, they will be combined into one OTR distribution. This will also be done between similar receptor types. Thus an OTR distribution could represent the combination of an number of land use categories and receptors for any given test parameter.

Appendix A3: Method for Determining OTR_{98} and Related Values

In most cases, the sample size of any given distribution will be such that the 97.5 percentile does not fall on a data point. The 97.5 percentile, as given by $\varepsilon_{0.975}$ in Table A1, will fall between two data points. In this case the value for the OTR_{98} is determined by interpolating between the two points on each side. As the majority of the distributions are highly skewed to the right, the interpolation is done on log transformed data.

When 97.5 percentile is not an integer, the OTR_{98} is calculated with the following equation:

$$OTR_{98} = 10^{logX_{(r-1)} + (logX_{(r)} - logX_{(r-1)})*mod0.975n}$$

where - n is the sample size
-$X_{(r)}$ is the value of the data point on the right of $\varepsilon_{.975}$
- $X_{(r-1)}$ is the value of the data point on the left of $\varepsilon_{.975}$

When the OTR_{98} falls on a data point that is a <w result or falls between two data points that are <w, the OTR_{98} is set to the <w value and is called a provisional OTR_{98P}. If the data point to the left of the OTR_{98} is a <w but the data point to the right of the OTR_{98} is a real number, the above method is still used to calculate the OTR_{98} but it is also considered provisional. The OTR_{98} will also be considered provisional if the lower confidence limit (LCL) is also a <w result.

Appendix A4: Details of Graphical Representation of OTR Distributions

In order to convey as much information as possible about an OTR to an investigator to assist in the interpretation of field data, each OTR will be represented graphically. For each test parameter/receptor(s) combination, there will be a full page graph that shows the OTR for each land use category for that combination. Where there are fewer than four land use categories for a test parameter/receptor(s) combination, two graphs may be included on one page.

The following is a detailed description for producing an OTR graphic on a 8.5 x 11 inch page. When the graphic is incorporated into a word processing package, it may be slightly reduced in size to fit.

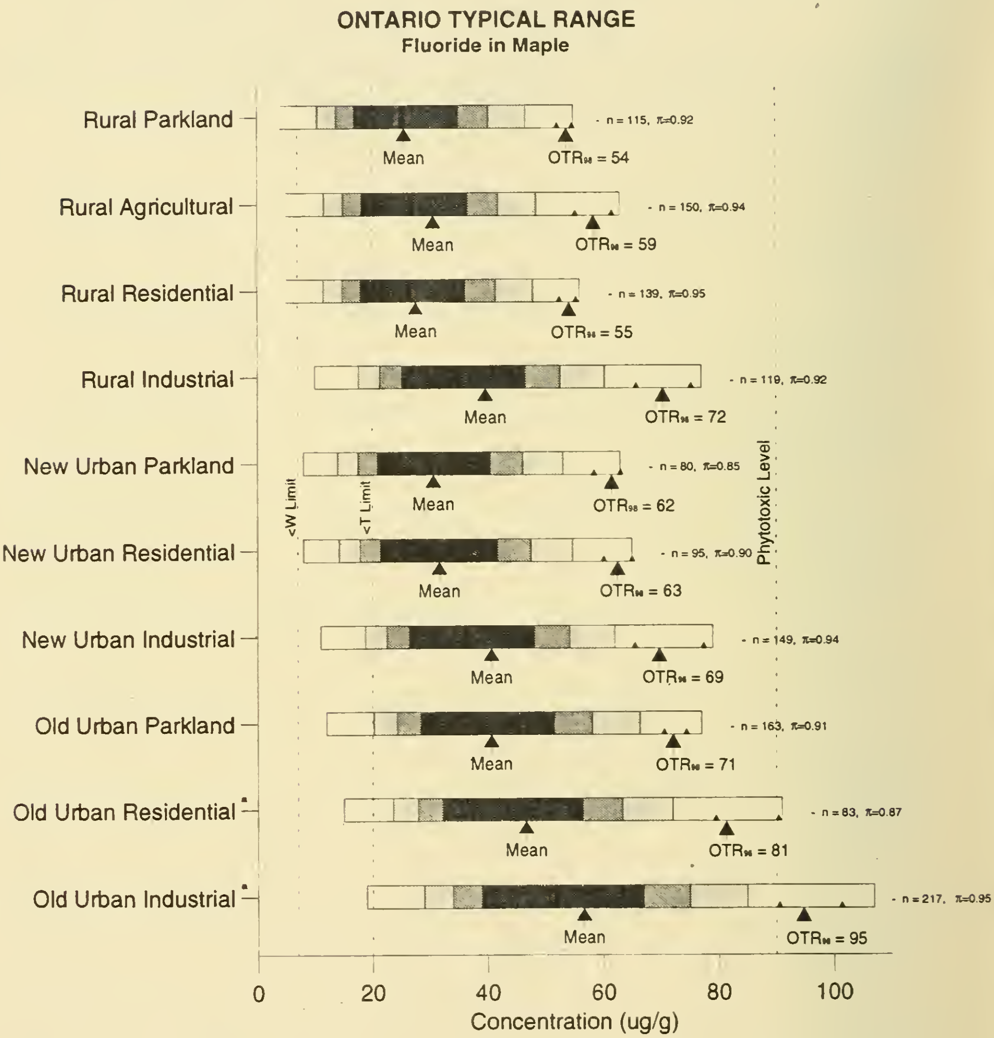
1. Title "Typical Ontario Range" - Helvetica Bold type face, 5 mm, capitalized lower case, located in the center of the page and 55 mm from the top of the page.
2. Secondary title "test parameter in receptor(s) type" - Helvetica Bold, 4 mm, capitalized lower case, located in the center of the page and 61 mm from the top of the page.
3. A third subtitle "For Regions Rejected by the KS Test" - Helvetica, 4 mm, capitalized lower case, located in the center of the page and 67 mm from the top of the page. This subtitle is only printed for those OTR graphs created for rejected regions.
4. Y axis - a vertical line starting 60 mm from the left edge and 70 mm from the top of the page. The line is 15 mm long for every land use category in the graphic for a maximum of 150 mm.
5. X axis - a horizontal line 110 mm long starting at the lower end of the Y axis and going to the right.
6. Y axis ticks - all ticks are 3 mm long horizontal lines to the left of the Y axis. They start 10 mm from the bottom of the Y axis and are spaced 15 mm apart.
7. X axis tick - all ticks are 3 mm long vertical lines below the X axis. They start at the left end of the X axis and are spaced depending on the number of labels used (see below for X axis labels)
8. Y axis labels - the Y axis labels are the land use categories. These are in Helvetica type face, 4 mm, capitalized lower case starting 1 mm to the left and centered on the Y axis tick marks. The land use categories labels are in the following order from the bottom up: Old Urban Industrial, Old Urban Residential, Old Urban Parkland, New Urban Industrial, New Urban Residential, New Urban Parkland, Rural Industrial, Rural Residential, Rural Agricultural, and Rural Parkland.
9. Footnotes and footnote labels - footnotes may be necessary at times to describe limits set on the land use category or the receptor type. Footnotes are identified by superscript lower case Helvetica, 2 mm, type. The first footnote starts with the letter "a" and the following are incremented from "a". The actual footnotes are located 10 mm below the X axis label and 50 mm from the left edge of the page. The footnote text is Helvetica, 2.5 mm, lower case, type face.
10. X axis values - the X axis values are the test parameter values. These are Helvetica type face, 4 mm, starting 1 mm below and centered on the X axis tick marks. The values will have no more than two significant digits. The range is from 10% below the smallest minimum value from all of the OTR distributions to 10% above the largest maximum value from all of the OTR distributions. There are no more than 7 labels and no fewer than 5 labels.
11. X axis label - the X axis label includes the units of measurement in brackets and an appropriate description such as "Concentration". The label is Helvetica type face, 4 mm, capitalized lower case starting 3 mm below the X axis values and centered in the middle of the axis.

12. <W and <T limits - are the most recent analytical reporting limits (see glossary for definition). The <W and <T limits are vertical lines that are the full length of the Y axis. The lines are a fine dotted line that breaks where they cross an OTR distribution. The label "<W Limit" and "<T Limit" in Helvetica type face, 2.4 mm, capitalized lower case, are located to the left of their corresponding lines at right angles to the graphic titles.
13. Phytotoxic Concentration/Decommissioning Guideline - where a phytotoxic concentration, Decommissioning Guideline, or any other such limit, exists there is a fine dotted vertical line at that concentration and is the full length of the Y axis. The line will break where it crosses an OTR distribution. The label "Phytotoxic Concentration" in Helvetica type face, 2.5 mm, capitalized lower case, located in the center, to the left and parallel to the line.
14. OTR distribution - the OTR distribution for each land use category is a 4mm thick bar going from the minimum value on the left to the maximum value on the right. The bar maximum length can not exceed 80% of the X axis length or 88 mm. The bar consists of a series of horizontally stacked boxes. Each box represents 10% of the distribution population. The boxes representing 0 to 10% and 90 to 100% are white. The boxes representing 10 to 20% and 80 to 90% are shaded at a 5% grey level. The boxes representing 20 to 30% and 70 to 80% are shaded at a 15% grey level. The remaining boxes, 30 to 60% are shaded at a 50% grey level. The shading is done to assist in the rapid determination as to where a result would fall within the OTR distribution. Where a box crosses the detection limit range the box to the left of the range will be open ended and the line will be a dash instead of solid.
15. Mean - the arithmetic mean of each OTR distribution is indicated on each distribution bar. It is indicated by an arrow, 2 mm tall triangle with a 1 mm stem, touching the bottom edge of the distribution bar. One mm below and centered on the arrow is the word "Mean" in Helvetica type, 3 mm, capitalized lower case.
16. Median - the median is the point where the 40-50% and 50-60% boxes meet. This point is represented by a black line, 1 mm thick, between the two boxes.
17. OTR_{98} - the OTR_{98} value for a distribution is indicated on each distribution bar. It is indicated by an arrow, 2 mm tall triangle with a 1 mm stem, touching the bottom edge of the distribution bar. One mm below and centered on the arrow is the word "OTR_{98}". The "OTR" is in Helvetica type, 3 mm, upper case and the "98" is in Helvetica type, 1.75 mm, upper case. In the case of provisional OTRs OTR_{98P} is used. This is followed by an equal sign and the actual OTR_{98} value to two significant figures.
18. OTR_{98} confidence intervals - are indicated by 1 mm tall triangles to the right and left of the OTR_{98} with the base of the triangle on the bottom of the distribution bar. Where the confidence intervals are less than or equal to W they are not shown.
19. n & π values - the n value is the total number of sites used in each OTR distribution and the π value is the confidence level for the OTR_{98} confidence limits. These values are located 5 mm to the right and centered on the OTR distribution bar. The values are in Helvetica 2.5 mm, lower case type face, with the n value first followed by the π value separated with a comma.

An example of an OTR graphic with all of the possible features that may be included in an OTR graphic is given on the following page. The data used in making the example are hypothetical.

The OTR graphics are generated automatically by the OTR database program once a year as part of the OTR revision and maintenance process. In addition, a program routine within the Phytotoxicology Section database will automatically generate the necessary OTR distribution bar and OTR_{98}. These can be used by the investigators when preparing reports to assist in the data interpretation and for direct import into the final report if desired.

Figure B1: Example of an OTR Graphic Showing all of the Possible Features



[a] - does not apply to striped or sugar maple

Appendix B: Test Parameter Information

The information in the following tables is a summary of the analytical methods for each of the OTR test parameters for each receptor type. This information is provided for the sole purpose of comparing results obtained using other analytical methods with the OTR data. For more detailed, up to date information on the analytical methods referred to the references or contact the OMOEE Laboratory Service Branch (OMOEE, QA/QC Bulletin Board Service at 41-235-6136 or C. Raposo at 416-235-6005).

Some of the test parameters are not routinely done by the OMOEE, Laboratory Services Branch and were done by private laboratories. As a result there are no method details available.

The Reporting Limits (W) and Method Detection Limits (MDL) listed in the tables for each method are only estimates. These values change with time.

Most of the methods, especially for the inorganics test parameters, do not yield total amounts of an analyte in a sample. The % of Total Measured value in the tables is based on one Canadian Centre for Inland Waters standard sediment sample for soil or a NBS orchard leaves certified standard sample for vegetation and cannot be used to imply recovery rates from all sample types and levels of contamination. As the concentration of most parameters are low in these standard samples, the percent recovery rate for the higher concentrations of a parameter may be higher than those reported in the table.

Table B1: Soil Sample Inorganic Test Parameters

Test	Reporting Limit (W) µg/g	% of Total Measured[*]	Instrumentation	Digestion/ Preparation	Weight Needed g	Reference[#]
Al	200	34±10	ICP, AA	HNO_3/HCl	0.5	(23),(38)
B	0.50	NA				(23)
Ba	0.50	NA				(23),(38)
Be	0.50	NA				(23)
Ca	100	45±15				(23),(38)
Cd	0.05	79± 9				(23),(38)
Co	0.20	43±15				(23),(38)
Cr	1.0	56±20				(23),(38)
Cu	1.0	70± 7				(23),(38)
Fe	200	66±13				(23),(38)
Mg	50	86±25				(23),(38)
Mn	5.0	69±15				(23),(38)
Mo	0.20	NA				(23),(38)
Ni	0.50	69± 7				(23),(38)
Pb	2.0	85±15				(23),(38)
Sr	1.0	NA				(23)
Tl	0.10	NA				(23),(38)
V	1.0	65±10				(23),(38)
Zn	5.0	85± 5				(23),(38)
Na	5.0	NA	AA			(24),(38)
K	5.0	NA	AA			(24),(38)
Ag	0.05	NA	AA	HNO_3/H_2SO_4	0.5	(24)
Hg	0.01	97±	Flameless AA		0.25	(22)
Cl	0.5	NA	I.S.E.	water extract	3.0	(21)
S	10	84± 4	Leco Furnace		0.25	(25)
F	0.50	NA	I.S.E.	$HClO_4$ extract	0.5	(29)
N (tot.)	0.10	NA	Colourimetry	H_2SO_4	0.4	(26)
P (tot.)	0.02	NA	Colourimetry	H_2SO_4	0.4	(26)
As	0.2	NA	Flameless AA	hydride	0.06	(20)
Se	0.2	NA				(20)
Sb	0.2	NA				(20)
Ti	10	NA	X-ray	wax pellet	0.25	NA
U	0.20	NA	ICP MS	HNO_3	0.2	(28)
CN						
Cr (VI)						
pH	0.05		Potentiometry	water extract	10	(48)
EC			Conductance	water extract	10	(49)
SAR						
Organic Carbon	0.05%	NA	LOI		1.0	(27)
			Minimum Total Weight		**30.86g**	

I.S.E. - Ion Selective Electrode AA - Atomic Absorption Spectrometry

NA - not available

[*] - % of Total Measured is based on one Canadian Centre for Inland Waters standard sediment sample and cannot be used to imply recovery rates from all soil types and levels of contamination.

[#] - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136.

As the Lab requires at least twice the minimum to allow for re-analysis and as there should be enough to archive for analysis in the future, a minimum of four times the minimum total is required. For soil samples, 150 g of air dried sample is required when collecting samples for OTR's.

Table B2: Vegetation Sample Inorganic Test Parameters

Test	Reporting Limit (W) µg/g	% of Total Measured[*]	Instrumentation	Digestion/ Preparation	Weight Needed g	Reference[•]
Al	5.0	90	ICP, AA	HNO_3/HCl	0.5	(13),(14),(38)
B	1.0	NA				(13),(14)
Ba	0.50	>90				(13),(38)
Be	0.05	NA				(13)
Ca	50	90				(13),(14),(38)
Cd	0.10	>90				(13),(38)
Co	0.20	>90				(13),(38)
Cr	0.50	96				(13),(38)
Cu	0.50	88				(13),(38)
Fe	5.0	70				(13),(38)
Mg	20, NA	92				(13),(14),(38)
Mn	0.50	91				(13),(38)
Mo	0.20	>90				(13),(38)
Ni	0.50	85				(13),(38)
Pb	0.50	94				(13),(38)
Sr	0.20	>90				(13)
V	0.50	>90				(13),(38)
Zn	1.0	96				(13),(38)
Na	2.0	>75	AA			(15),(38)
Ag	0.02	NA	AA	HNO_3/H_2SO_4	0.5	(15)
Hg	0.01	86	Flameless AA		0.25	(22)
Cl	20	100	X-ray	wax pellet	2.0	(19)
S	100	81				(19)
K	20	105				(19),(38)
F	0.50	NA	I.S.E.		0.5	(12)
N (total)	0.20	NA	Colourimetry		0.4	(16)
P (total)	0.02	NA	Colourimetry		0.4	(16)
As	0.2	>90	Flameless AA	hydride	0.06	(20)
Se	0.2	>90				(20)
Sb	0.2	>90				(20)
Ti	0.10	>90	ICP	H_2SO_4	0.25	(17),(13)
U	0.20	>90	ICPMS	HNO_3	0.2	(18)
Tl						
			Minimum Total Weight		**4.36g**	

I.S.E. - Ion Selective Electrode, AA - Atomic Absorption Spectrometry, NA - not available

[*] - % of Total Measured as determined on NBS orchard leaves certified standard sample.

[•] - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136.

As the Lab requires at least twice the minimum to allow for re-analysis and as there should be enough to archive for analysis in the future, a minimum of four times the minimum total is required. For vegetation samples, 18 g, dry weight, of sample is required when collecting samples for OTR's.

Table B3: Snow Sample Inorganic Test Parameters

Test	Reporting Limit µg/l	Preservative	Instrumentation	Volume Meltwater ml	Reference[#]
Al	5	HNO_3	ICP, AA	500	(47)
Ag	0.5				(47)
B	0.2				(30)
Ba	1				(47)
Be	1				(47)
Cd	0.2				(47)
Co	1				(47)
Cr	1				(47)
Cu	0.5				(47)
Fe	5.0				(47)
Mn	1				(47)
Mo	0.5				(47)
Ni	1				(47)
Pb	2				(47)
Ti[T]	1				(47)
U[C]	0.02				(30)
V	2				(47)
Zn	1				(47)
As	0.2		Flameless AA		(45)
Se	0.2				(45)
Sb	0.2				(45)
Hg[1]	0.02	HNO_3/K_2CrO_4	Cold Vapour AA	200	(39)
Ca	100		ICP[T],AA[C]	100	(46),(50)
Mg	20				(46)
Na	2				(46)
K	2				(46)
Cl	50		Col. Titration[T] Ion Chrom.[C]	50 25	(35),(32)
S (as SO_4)	50		Ion Chrom.	25	(42),(32)
F	10		I.S.E.	50	(37)
N (as NO_4)	10		Col. Titration	50	(40)
P	1		Col. Titration	50	(40)
Alkalinity			Auto Titration	75	(36)
Sus. Solids	1000		Gravimetric	500	(44)
Dis. Solids	5000				(41)
Tot. Solids	5000				(43)
D.O.C.	1000		Colourimetric	500	(34)
D.I.C.					
P.T.C.	200		Carbon Analyzer		(31)
Lignins					
Tannins					(33)
Conductivity	1.0[2]		Cond. Cell	75	(36)
			Minimum Total Volume	**1,725 ml**	

I.S.E. - Ion Selective Electrode, AA - Atomic Absorption Spectrometry

[T] - Thunder Bay Laboratory, [C] - Central Laboratory, [1] - glass bottle, [2] - µs/cm

[#] - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136.

Table B4a: Soil Sample Organic Test Parameters

Test	MDL* ng/g	Instrumentation	Preparation /Extraction	Weight Needed g	Reference#
Monocyclic Aromatics					
Benzene	2.0	GC/MS	Heated purge and trap or headspace GC/MS.	NA	NA
Ethylbenzene	2.0			NA	NA
Styrene	2.0			NA	NA
Toluene	2.0			NA	NA
o-Xylene	2.0			NA	NA
m/p-Xylene	2.0			NA	NA
Polycyclic Aromatics				NA	NA
acenapthene	50	GC/MS	Spiked with D8 napthalene and 2 labelled surrogates prior to extraction. Extracted in organic solvent and cleaned as necessary.	NA	NA
5-Nitro acenaphthene	100			NA	NA
Acenapthylene	50			NA	NA
Anthracene	50			NA	NA
Benzo(a)anthracene	50			NA	NA
Dibenzo(a,h)anthracene	100			NA	NA
Camphene	50			NA	NA
Chrysene	50			NA	NA
Fluoranthene	50			NA	NA
Benzo(b)fluoranthene	50			NA	NA
Benzo(k)fluoranthene	50			NA	NA
Fluorene	50			NA	NA
Indole	50			NA	NA
Napthalene	50			NA	NA
1-Chloronapthalene	50			NA	NA
2-Chloronapthalene	50			NA	NA
1-Methyl napthalene	50			NA	NA
2- Methly napthalene	50			NA	NA
Perylene	50			NA	NA
Benzo(ghi)perylene	100			NA	NA
Phenanthrene	50			NA	NA
Pyrene	50			NA	NA
Benzo(a)pyrene	50			NA	NA
Indo(1,2,3-cd)pyrene	50			NA	NA
Halogenated Cyclics				NA	NA
Chlorobenzene	2.0	GC/MS	Heated purge and trap or headspace GC/MS.	NA	NA
1,2-Dichlorobenzene	2.0			NA	NA
1,3-Dichlorobenzene	2.0			NA	NA
1,4-Dichlorobenzene	2.0			NA	NA
Halogenated Aliphatics				NA	NA
Bromomethane	3.0	GC/MS	Heated purge and trap or headspace GC/MS.	NA	NA
Dibromochloromethane	3.0			NA	NA
Ethylene dibromide	4.0			NA	NA
Tribomomethane	2.0			NA	NA
Chloromethane	3.0			NA	NA
Dichloromethane	3.0			NA	NA
Trichloromethane	2.0			NA	NA
Trichlorofluoromethane	3.0			NA	NA
Carbon Tetrachloride	2.0			NA	NA

NA - information not available at this time.
* - estimated values for Method Detection Limit.
# - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136..

Table B4b: Soil Sample Organic Test Parameters (continued)

Test	MDL[*] ng/g	Instrumentation	Preparation /Extraction	Weight Needed g	Reference[#]
Halogenated Aliphatics				NA	NA
1,1-Dichloroethane	2.0	GC/MS	Heated purge and trap or headspace GC/MS.	NA	NA
1,2-Dichloroethane	2.0			NA	NA
1,1,2-Trichloroethane	2.0			NA	NA
1,1,1-Trichloroethane	2.0			NA	NA
1,1,2,2-Tetrachloroethane	4.0			NA	NA
Chloroethylene	3.0			NA	NA
1,1-Dichloroethylene	2.0			NA	NA
trans 1,2-Dichloroethylene	3.0			NA	NA
Trichloroethylene	4.0			NA	NA
Tetrachloroethylene	2.0			NA	NA
1,2-Dichloropropane	2.0			NA	NA
cis-1,3-Dichloropropylene	2.0			NA	NA
trans 1,3-Dichloropropylene	3.0			NA	NA
Phenolics				NA	NA
m-Cresol	100			NA	NA
o-Cresol	100			NA	NA
p-Cresol	100			NA	NA
4,6-Dinitro-o-cresol	100			NA	NA
Phenol	100			NA	NA
2-Chlorophenol	100			NA	NA
2,4-Dichlorophenol	100			NA	NA
2,6-Dichlorophenol	100			NA	NA
2,3,4-Trichlorophenol	100			NA	NA
2,3,5-Trichlorophenol	100			NA	NA
2,4,5-Trichlorophenol	100			NA	NA
2,4,6-Trichlorophenol	100			NA	NA
2,3,4,5-Tetracholorphenol	100			NA	NA
2,3,4,6-Tetracholorphenol	100			NA	NA
2,3,5,6-Tetracholorphenol	100			NA	NA
Pentachlorophenol	100			NA	NA
4-Chloro-3-methylphenol	100			NA	NA
2,4-Dimethylphenol	200			NA	NA
4-Nitrophenol	200			NA	NA
2,4-Dinitrophenol	200			NA	NA
Pesticides				NA	NA
Aldrin	50	GC/MS	Sample spiked with three labelled surrogates prior to extraction. Extracted with solvent and cleaned if necessary.	NA	NA
Carbaryl	50			NA	NA
a-Chlordane	50			NA	NA
g-Chlordane	50			NA	NA
O,P-DDT	50			NA	NA
P,P-DDT	50			NA	NA
DDT	50			NA	NA
2,4-D	100			NA	NA
Diazinon	50			NA	NA
Dieldrin	50			NA	NA

NA - information not available at this time.

[*] - estimated values for Method Detection Limit.

[#] - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136.

Table B4c: Soil Sample Organic Test Parameters (continued)

Test	MDL[*] ng/g	Instrumentation	Preparation /Extraction	Weight Needed g	Reference[•]
Pesticides				NA	NA
Endrin	50	GC/MS	Sample spiked with three labelled surrogates prior to extraction. Extracted with solvent and cleaned if necessary.	NA	NA
Hepachlor	50			NA	NA
Heptachlor epoxide	50			NA	NA
Lindane	50			NA	NA
Methoxychlor	50			NA	NA
Methyl Parathion	50			NA	NA
Parathion	50			NA	NA
Silvex	100			NA	NA
Toxaphene	1000			NA	NA
Total PCBs	300	GC/MS,GC/ECD	Spiked with minimum one surrogate prior to extraction. Extracted with organic solvent and cleaned if necessary.	NA	NA
				NA	NA
				NA	NA
				NA	NA
				NA	NA
Dioxins and Furans				NA	NA
Tetrachlorodibenzofurans	.002	GC/hi-res MS or tandem MS	Spiked with labelled analogs of PCDD and PCDF prior to extraction. Extracted with toluene. Cleaned using series of liquid/solid chromatographic columns and HPLC if necessary.	NA	NA
Pentachlorodibenzofurans	.005			NA	NA
Hexachlorodibenzofurans	.005			NA	NA
Heptachlorodibenzofurans	.005			NA	NA
Octachlorodibenzofurans	.010			NA	NA
Tetrachlorodibenzo-p-dioxin	.002			NA	NA
Pentachlorodibenzo-p-dioxin	.005			NA	NA
Hexachlorodibenzo-p-dioxin	.005			NA	NA
Heptachlorodibenzo-p-dioxin	.005			NA	NA
Octachlorodibenzo-p-dioxin	.010			NA	NA
2,3,7,8-Tetrachloro-p-dioxin	.002			NA	NA

NA - information not available at this time.

[*] - estimated values for Method Detection Limit.

[•] - The most up to date references for these method can be obtained from the OMOEE, QA/QC BBS at 416-235-6136.

Appendix C: Derivation of 2,3,7,8-TCDD Toxic Equivalents (TEQ)

For OTR samples collected and analyzed for dioxins and furans after the fall of 1991, isomer specific results were obtained for each sample. The 2,3,7,8-TCDD Toxic Equivalents (TEQ) are calculated for each sample using the International Toxic Equivalency Factor scheme (I-TEF) proposed by NATO-CCMS report No. 176 (3). The I-TEF factors for seventeen dioxin and furan congeners are give in Table C.1 below.

Table C.1: International Toxicity Equivalency Factors (I-TEF) for Congeners of Concern

Congener of Concern	I-TEF
2,3,7,8-TCCD	1
1,2,3,7,8-P5CDD	0.5
1,2,3,4,7,8-H6CDDD	0.1
1,2,3,7,8,9-H6CDDD	0.1
1,2,3,6,7,8-H6CDDD	0.1
1,2,3,4,6,7,8-H7CDD	0.01
1,2,3,4,6,7,8,9-O8CDD	0.001
2,3,7,8-TCDF	0.1
2,3,4,7,8-P5CDF	0.5
1,2,3,7,8-P5CDF	0.05
1,2,3,4,7,8-H6CDF	0.1
1,2,3,7,8,9-H6CDF	0.1
1,2,3,6,7,8-H6CDF	0.1
2,3,4,6,7,8-H6CDF	0.1
1,2,3,4,6,7,8-H7CDF	0.01
1,2,3,4,7,8,9-HCDF	0.01
1,2,3,4,6,7,8,9-O8CDF	0.001

Prior to the fall of 1991, the OTR samples were analyzed for the one specific isomer, 2,3,7,8-TCDD, and the totals for each of the dioxin and furan isomer groups. In order to estimate 2,3,7,8-TCDD Toxic Equivalents from the OTR data prior to the fall of 1991, a slightly modified version of a method for applying the I-TEF scheme to dioxin and furan mixture data was used (1)(2). The modified version was provided by staff of OMOEE, Hazardous Contaminants Branch (personal communication). With the exception of the T5CDD isomer group, a proportional factor is applied to each isomer group result and the I-TEF is applied to the resultant. A proportional factor is not applied to the T4CDD group as the 2,3,7,8-TCDD concentration is known. These proportional factors are based on the relative abundance of 2,3,7,8-substituted congeners found in ambient air, soil and sediment samples, and represent the upper limit for each. The proportional factors for each isomer group and the method used to determine the total TEQ for each sample is given in Table C.2

Table C.2: Method Used to Calculate TEQ for OTR Samples Analyzed Prior to the Fall of 1991

Isomer Group		Proportional Factor		I-TEF	
2,3,7,8-TCDD	x	100%	x	1	= TEQ
T4CDD	x	0%	x	1	= 0
P5CDD	x	10%	x	0.5	= TEQ
H6CDD	x	30%	x	0.1	= TEQ
H7CDD	x	60%	x	0.01	= TEQ
O8CDD	x	100%	x	0.001	= TEQ
T4CDF	x	10%	x	0.1	= TEQ
P5CDF	x	15%	x	0.55	= TEQ
H6CDF	x	50%	x	0.1	= TEQ
H7CDF	x	75%	x	0.01	= TEQ
O8CDF	x	100%	x	0.001	= TEQ
				Total	TEQ

For each of the two methods described above, the total TEQ is calculated for each sample. The resulting TEQs for all the samples at a site are then combined and the average for the site is used in the determination the OTR. In the case of data being reported as being below W, one half of W is used in the calculation of the TEQ. There is no W equivalent for the TEQ.

Appendix D: Brief Description of OTR's for Inclusion in Reports

The following is a brief description of the derivation and significance of the OTR's that will be appended to all Phytotoxicology reports in which OTR's are used or sited.

Derivation and Significance of OMOEE "Ontario Typical Range" of Chemical Parameters in Soil, Vegetation, Moss bags and Snow

The OMOEE "Ontario Typical Range" (OTR) was developed by the Ontario Ministry of the Environment to assist in the interpretation of analytical data and in the evaluation of source related impacts. The OTR's are used to determine whether the level of a contaminant in surface soil, specific groups of plants, moss bags or snow is significantly above that which would be anticipated for the normal level of human activity in the area sampled. An exceedence of the OTR_{98} for a plant species group, soil, moss bag or snow sample from a given land use category would indicate a potential point source of contamination.

The OTR's essentially represent the expected range of concentrations of contaminants in surface soil, specific groups of plants, moss bags and/or snow from areas in Ontario not subjected to the influence of known point sources of emissions. These ranges are based on samples collected from the different land use categories for which they have been developed.

In addition to the OTR ranges, an upper limit referred to as the OTR_{98} has been developed. The OTR_{98} represents 97.5 percent of data in the OTR distribution. This is equivalent to the mean plus two standard deviations of the data, which is similar to the previous OMOEE "Upper Limit of Normal" or ULN guidelines.

The degree of contamination of a receptor from non-point sources depends on the amount and type of human activity, both past and present. Therefore, OTR's have been developed for different land use categories that reflect the level of human activity. The three main land use categories are Rural, New Urban and Old Urban. Urban is defined as an area that has municipal water and sewage services. Old Urban is any area that has been developed as an Urban area for more than 40 years. Rural is all other areas. Each of these major land use categories has been broken into Parkland/Greenbelt/Woodlands, Residential and Industrial/Commercial/Transportation Rights-of-Way. Rural also includes an Agricultural category.

These guidelines apply only to samples collected using standard Ministry of the Environment sampling, sample preparation, and analytical techniques (6),(7) and (12)-(47). As the OTR's are developed from data collected in Ontario, they are only valid for samples collected in Ontario.

The OTR's are not the sole means by which results are interpreted. In interpreting results, the results from control samples and the pattern of contamination observed in the samples are also used. The OTR's are to assist where there is some question concerning the local background samples and/or enough samples have not been collected to determine any pattern of contamination. OTR's are also used to determine where in the anticipated range a result falls. This can be used to indicate a potential level for concern even when a result falls within the guideline.

The OTR's for each receptor/land use category assume a given range of contamination resulting from normal human activity for that land use category. ***As a result, it must be stressed that values falling within the OTR's should not be considered as acceptable or desirable levels; nor do they imply toxicity to plants, animals or humans.*** Rather, they serve as levels which, if exceeded, would prompt further investigation on a case by case basis to determine the significance, if any, of the above normal concentration(s). Incidental, isolated or spurious exceedences of an OTR_{98} shall not necessarily indicate a need for regulatory or abatement activities. However, repeated and/or extensive exceedences of an OTR which can be related temporally or spatially to a source characterized by emission of a contaminant[3] will indicate a need for a thorough evaluation of the regulatory or abatement program.

Where an OTR exists for a given receptor/land use category, the OTR will supersede the Phytotoxicology Upper Limit of Normal (ULN) for the interpretation of results. If an OTR does not exist, the ULN will be used.

---

[3] Contaminant as defined in Section 1.1.C of the Environmental Protection Act(11).

Appendix E: Members of the OTR Committee

Chairman

Randall D. Jones	Phytotoxicology Section

Members

Seepersaud (Bis) Bisessar	Phytotoxicology Section
Ber-Lin (Bob) Chai	Phytotoxicology Section
Robert N. Emerson	Phytotoxicology Section
William I. Gizyn	Phytotoxicology Section
Allen L. Kuja	Phytotoxicology Section
Marius H. Marsh	Phytotoxicology Section
Kathryne McDonald	Mid Ontario Region
William D. McIlveen	Phytotoxicology Section
David L. McLaughlin	Phytotoxicology Section
John J. Negusanti	Mid Ontario Region
Ronald G. Pearson	Phytotoxicology Section
Donald J. Racette	Northern Region

For information concerning OTRs please contact Randall Jones at:

Ministry of the Environment and Energy
Standards Development Branch
Phytotoxicology Section
135 St. Clair Ave. E, Suite 100
Toronto, Ontario
M4V 1P5

phone: 905-456-2504 ext 324
fax: 905-456-1003

Appendix F: Glossary of Terms and Abbreviations

Control	A control sample or station as referred to in this document is not a true control from a scientific stand point but is actually a check sample or station. The term is used here as it has been used in the past in Phytotoxicology reports.
Land Use	This term as used in this document refers to the type and level, both past and present, of human activity in an area that is sampled.
LCL	Is the lower confidence limit for the OTR_{98} as calculated using the method "Distribution Free Confidence Limits for Quantiles" described in appendix A1.
LIS	Is the abbreviation for the Laboratory Services Branch "Laboratory Information System" database system.
MDL	Is the analytical method detection limit and is approximately three times S_w. S_w is the within-run analytical standard deviation.
OMOEE	Is the abbreviation for the "Ontario Ministry of Environment and Energy".
Moss Bag	These are artificial tools developed by the Phytotoxicology Section for monitoring the levels of various air contaminants in the environment. For a more detailed description see (6).
Parameters	This term as used in this document refers to analytical tests performed on the various receptors. These are usually inorganic chemical analysis but can be physical tests as well.
Phytotoxic	A substance is considered phytotoxic if it causes injury to plants. A phytotoxic level is the concentration in the air, soil or plant tissue at which a substance causes injury to plants. Injury includes visible symptoms such as necrosis or chlorosis and/or a statistically significant change (usually a reduction) in any physical or biochemical measurement by 5% in comparison with control samples.
Quantile	The quantile of a sample is the data point corresponding to a given fraction of the data.
Receptor	A receptor as used in this document refers to a part of the environment, soil, plant foliage, snow and moss bag, that is exposed to and accumulates contaminants.
SDF	Is the abbreviation for "Station Description File". This file contains information about the sampling points or stations located throughout the Province of Ontario. Each record on the file contains a verbal description of a sampling point plus various codes designating its geographical location.
SIS	Is the abbreviation for "Sample Information System". This is a database located on the Ontario Government's mainframe computer located in Downsview in which all the results from the analysis of samples collected and analyzed by the OMOEE are stored.
UCL	Is the upper confidence limit for the OTR_{98} as calculated using the method "Distribution Free Confidence Limits for Quantiles" described in appendix A1.

ULN	Is the abbreviation for the Phytotoxicology Section's "Upper Limit of Normal" guidelines.
Vegetation	In the context of this document refers to the foliage only of most plant species. Grass and forage includes plant stems. Guidelines may be developed for twigs or other plant parts at some future date.
<T	Is a qualifier used by the Laboratory Services Branch, OMOEE when reporting analytical results. The reported value is a tentative, or trace amount; interpret with caution. The T value for soil and vegetation samples is usually two time the method detection limit (see MDL above) and ten times W.
<W	Is a qualifier used by the Laboratory Services Branch, OMOEE when reporting analytical results. The sample may contain the analyte but the level would probably not exceed the Laboratory Method Detection Limit. The W value is equivalent to the S_w, which is the within-run analytical standard deviation, always rounded down. The W value is approximately 1/3 to 1/5 the MDL.
π	Is the confidence level, $(1-\alpha)$, for the confidence limits around the OTR$_{98}$ as calculated using the method "Distribution Free Confidence Limits for Quantiles" described in appendix A1.
$\bar{x}$CV	Average within site sampling variability around the OTR$_{98}$, expressed as a percent coefficient of variability (CV). This is calculated by taking the average of the within site CV's of all the points between the OTR$_{98}$ upper and lower confidence limits.

Appendix G: OTR Sampling Regions

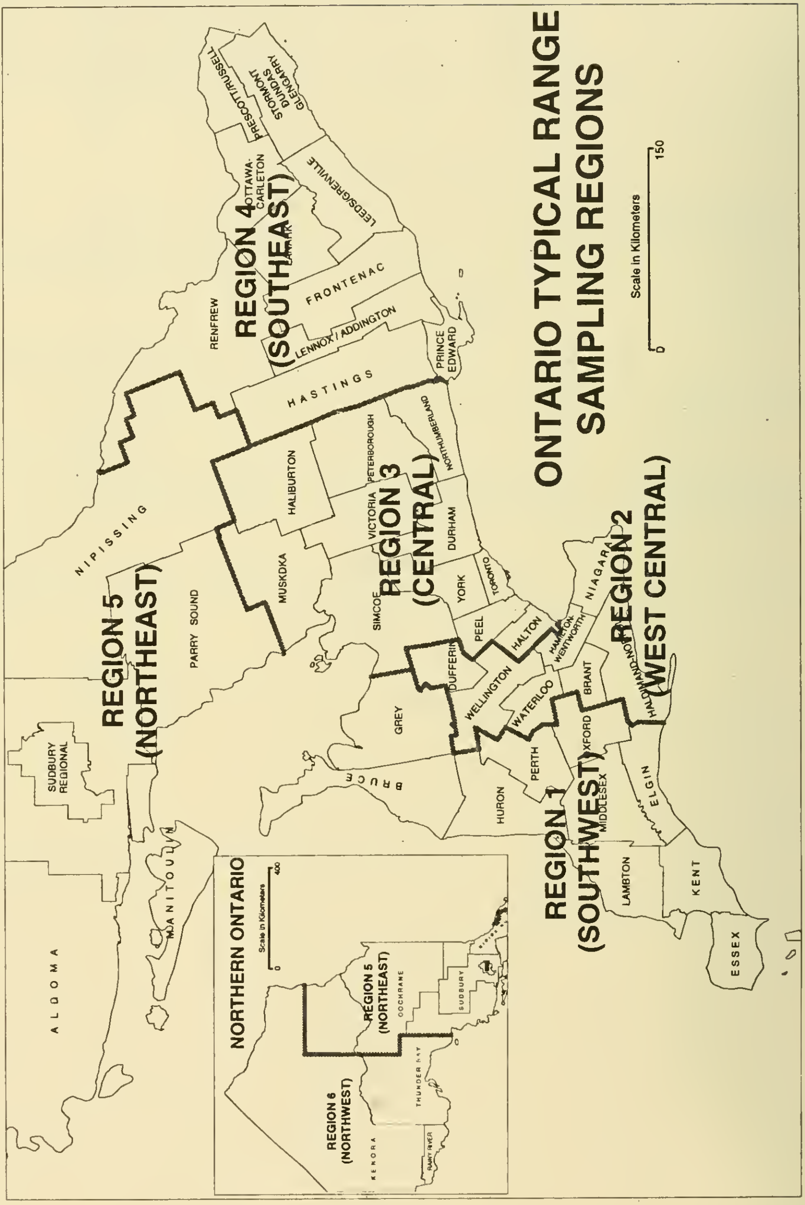
The OTR sampling regions are based on the pre August 1, 1993, Ontario Ministry of Environment and Energy Regions, see map below. As these OMOEE Regional boundaries change over time, it was decided that for the purposes of the OTRs, the OTR sampling regions would be fixed on the OMOEE Regions that existed at the start of the OTR sampling program. These regions divided along county boundaries. The counties included in each OTR sampling region are given in Table G1 and Figure G1 below.

Table G1: Counties That Make Up the OTR Sampling Regions

OTR Region	Counties
Region 1 (Southwest Region*)	Bruce, Elgin, Essex, Grey, Huron, Lambton, Kent, Middlesex, Oxford, Perth
Region 2 (West Central Region*)	Brant, Dufferin, Haldimand-Norfolk, Hamilton-Wentworth, Niagra, Waterloo-Cambridge, Wellington
Region 3 (Central Region*)	Durham, Haliburton, Halton, Muskoka, Northumberland, Peel, Peterborough, Simcoe, Toronto, Victoria, York
Region 4 (Southeast Region*)	Dundas-Stormont-Glengarry, Frontenac, Leeds-Grenville, Hastings, Lanark, Lennox-Addington, Ottawa-Carleton, Prescott-Russell, Prince Edward, Renfrew
Region 5 (Northeast Region*)	Algoma, Cochrane, Nipissing, Parry Sound, Sudbury
Region 6 (Northwest Region*)	Kenora, Rainy River, Thunder Bay

* - Pre August 1, 1993 OMOEE Region

Figure G1: Map of OTR Sampling Regions



Appendix H: References

(1) Birmingham, Brendan. 1990. Analysis of PCDD and PCDF patterns in soil samples in the estimation of the risk of exposure. Chemosphere, Vol. 20, No. 7-9, pp 807-814.

(2) Birmingham, Brendan. 1990. Application of the International Toxicity Equivalency Factor Scheme to PCDD/PCDF Mixtures lacking isomer specific information. Chemosphere, Vol. 20, No. 7-9, pp 815-820.

(3) NATO-CCMS report No. 178. 1988. Scientific basis for the development of the international toxicity equivalency factor (I-TEF) method of risk assessment for complex mixtures of dioxins and related compounds.

(4) Ontario Ministry of the Environment. 1989. Ontario Ministry of the Environment "Upper Limit of Normal" Contaminant Guidelines for Phytotoxicology Samples. ISBN 0-7729-5143-8. ARB-138-88-Phyto.

(5) Ontario Ministry of the Environment. 1989. Guidelines for the Decommissioning and Cleanup of Sites in Ontario. Waste Management Branch. ISBN: 0-7729-5278-7.

(6) Ontario Ministry of the Environment. 1993. Field Investigation Manual. Phytotoxicology Section - Air Resources Branch: Technical Support Sections - NE and NW Regions

(7) Ontario Ministry of the Environment. (Draft). Procedure Manual for Vegetation and Soils Processing Laboratory. Phytotoxicology Section - Air Resources Branch.

(8) Ministry of the Attorney General. 1989. Environmental Protection Act, Revised Statues of Ontario, 1980 Chapter 141, as amended by 1981, Chapter 49; 1983, Chapter 52; 1986, Chapter 68, ss. 1 to 17; 1988, Chapter 54, ss. 1 to 50; 1988, Chapter 71, s. 19 and 1989, Chapter 30 and Regulation 308 Revised Regulation of Ontario, 1980 as amended to O. Reg. 389/88. ISBN 0-7729-5651-0.

(9) Steel, R.G.D. and J.H. Torrie, Principles and Procedures of Statistics, A Biometrical Approach, Second Edition, pp. 540-542, McGraw-Hill Book Company, Toronto, 1980.

(10) David, Herbert A., Order Statistics, pp. 15-19, John Wiley and Sons, New York, 1981.

(11) Ontario Institute of Pedlology. Field Manual for Describing Soils. University of Guelph, Guelph, Ontario. 1982. O.I.P. Publication No. 82-1. ISBN 0-88955-008-5

(12) Ontario Ministry of the Environment. 1989. The determination of fluoride in vegetation by Ion Selective Electrode (I.S.E.). Laboratory Services Branch Catalog Number E3053A.1.

(13) Ontario Ministry of the Environment. 1989. The determination of metals in vegetation by ICP-AES. Laboratory Services Branch Catalog Number E3065A.1.

(14) Ontario Ministry of the Environment. 1991. The determination of metals in vegetation by sequential ICP-AES. Laboratory Services Branch Catalog Number E3066A.1.

(15) Ontario Ministry of the Environment. 1989. The determination of trace metals in vegetation by AAS. Laboratory Services Branch Catalog Number E3067A.1.

(16) Ontario Ministry of the Environment. 1989. The determination of nitrogen and phosphorus in vegetation by colourimetry. Laboratory Services Branch Catalog Number E3118A.1.

(17)Ontario Ministry of the Environment. 1990. The determination of titanium in vegetation by ICP-AES. Laboratory Services Branch Catalog Number E3205A.1.

(18) Ontario Ministry of the Environment. 1989. The determination of uranium in vegetation by ICP-MS. Laboratory Services Branch Catalog Number E3214A.1.

(19) Ontario Ministry of the Environment. 1989. The determination of Cl, K, S, Ca, P, and Si in vegetation by X-ray Fluorescence. Laboratory Services Branch Catalog Number E3234A.1.

(20) Ontario Ministry of the Environment. 1990. The determination of arsenic, selenium and antimony in vegetation, soils and sediments by HYD-FAAS. Laboratory Services Branch Catalog Number E3245A.1.

(21) Ontario Ministry of the Environment. 1989. The determination of water extractable chloride in soils and sediments by ion chromatrography. Laboratory Services Branch Catalog Number E3013A.1.

(22) Ontario Ministry of the Environment. 1989. The determination of mercury in soils, sediments and vegetation by AAS. Laboratory Services Branch Catalog Number E3059A.1.

(23) Ontario Ministry of the Environment. 1989. The determination of trace metals in soil by ICP-AES. Laboratory Services Branch Catalog Number E3073A.1.

(24) Ontario Ministry of the Environment. 1989. The determination of heavy metals in soils by AAS. Laboratory Services Branch Catalog Number E3075A.1.

(25) Ontario Ministry of the Environment. 1989. The determination of sulphur in soil, sediments, coal and ore by LECO Induction Furnace. Laboratory Services Branch Catalog Number E3096A.1.

(26) Ontario Ministry of the Environment. 1989. The determination of nitrogen and phosphorus in soil and sediment by colourimetry. Laboratory Services Branch Catalog Number E3116A.1.

(27) Ontario Ministry of the Environment. 1990. The determination of moisture content, RST, RSTA, and LOI in sediments by gravimetry. Laboratory Services Branch Catalog Number E3139A.1.

(28) Ontario Ministry of the Environment. 1989. Determination of uranium in soil and sediment by ICP-MS. Laboratory Services Branch Catalog Number E3215A.1.

(29) Ontario Ministry of the Environment. 1989. The determination of fluoride in soil, sediments and moss bag samples by ion selective electrode (I.S.E.). Laboratory Services Branch Catalog Number E3263A.1.

(30) Ontario Ministry of the Environment. 1989. The determination of trace metals in potable waters by ICP-MS. Laboratory Services Branch Catalog Number E3051A.1.

(31) Ontario Ministry of the Environment. 1990. The determination of Particulate Total Carbon in effluents, surface waters and sewage by LECO Carbon Analyzer. Laboratory Services Branch Catalog Number E3141A.1.

(32) Ontario Ministry of the Environment. 1989. The determination of chloride, nitrate and sulphate in wet deposition by automated ion chromotography. Laboratory Services Branch Catalog Number E3147A.1.

(33) Ontario Ministry of the Environment. 1989. The determination of tannins in liquids by colourmetry. Laboratory Services Branch Catalog Number E3202A.1.

(34) Ontario Ministry of the Environment. 1989. The determination of total organic carbon in sewage and industrial effluents by carbon analyzers. Laboratory Services Branch Catalog Number E3247A.1.

(35) Ontario Ministry of the Environment. 1990. The determination of chloride in surface water, sewage and industrial waste by colourimetry. Laboratory Services Branch Catalog Number E6002A.1.

(36) Ontario Ministry of the Environment. 1990. The determination of conductivity, pH and alkalinity in water and effluents by potentiometry. Laboratory Services Branch Catalog Number E6003A.1.

(37) Ontario Ministry of the Environment. 1990. The determination of fluoride in water and landfill leachates by ion selective electrode. Laboratory Services Branch Catalog Number E6007A.1.

(38) Ontario Ministry of the Environment. 1990. The determination of heavy metals in soil and vegetation by ICP-AES. Laboratory Services Branch Catalog Number E6012A.1.

(39) Ontario Ministry of the Environment. 1990. The determination of mercury in water, sewage, and industrial wastes by AAS. Laboratory Services Branch Catalog Number E6014A.1.

(40) Ontario Ministry of the Environment. 1990. The determination of ammonia nitrogen, nitrite nitrogen, nitrate and nitrite nitrogen and soluble phosphorus in surface and domestic waters, precipitation, sewages, landfills and industrial effluents by automated colourimetry AAII. Laboratory Services Branch Catalog Number E6024A.1.

(41) Ontario Ministry of the Environment. 1990. The determination of Dissolved Solids in water, rivers, sewage, landfill and industrial effluents by gravimetry. Laboratory Services Branch Catalog Number E6030A.1.

(42) Ontario Ministry of the Environment. 1990. The determination of sulphate in water, domestic water, precipitation, industrial waste and leachate samples by automated ion chromatography. Laboratory Services Branch Catalog Number E6032A.1.

(43) Ontario Ministry of the Environment. 1990. The determination of Total Solids in water, sewage and industrial effluents by gravimetry. Laboratory Services Branch Catalog Number E6034A.1.

(44) Ontario Ministry of the Environment. 1990. The determination of Particulate Solids in water, sewage and industrial effluents by gravimetry. Laboratory Services Branch Catalog Number E6035A.1.

(45) Ontario Ministry of the Environment. 1990. The determination of arsenic, selenium, and antimony in surface and drinking water by HYD-FAAS. Laboratory Services Branch Catalog Number E6038A.1.

(46) Ontario Ministry of the Environment. 1990. The determination of sodium, potassium, calcium and magnesium in water, sewage, leachates and industrial wastes by Flame-AAS. Laboratory Services Branch Catalog Number E6039A.1.

(47) Ontario Ministry of the Environment. 1990. The determination of trace metals in surface waters by preconcentration and ICP-AES. Laboratory Services Branch Catalog Number E6043A.1.

(48) Ontario Ministry of the Environment. 1990. The determination of pH in soil in a distilled water solution by potentiometry. Laboratory Services Branch Catalog Number E3038A.

(49) Ontario Ministry of the Environment. 1990. The determination of Conductivity in soils and sediments by conductivity meter. Laboratory Services Branch Catalog Number E3138A.

(50) Ontario Ministry of the Environment. 1990. The determination of sodium, potassium, calcium and magnesium in water, sewage, leachate and industrial waters by sequential ICP-AES. Laboratory Services Branch Catalog Number E6047A.